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An Account of the Minot Rock Lighthouse, Boston Harbor, Massachusetts; extracted from the Report of Col. J. J. Abert, *Chief, Topographical Engineers, to the* Hon. W. L. Marcy, *Secretary of War, November 17th*, 1848.

At the date of the last annual report, (October 15, 1847,) the condition of the work at the Minots was stated, and some of the difficulties which attended the operations of that season were specified. As the frame or main structure may now be considered completed, a brief description of the work, and some details connected with it during the progress of construction, may be regarded as not uninteresting.

Minot's Rocks, or, as they are generally designated, "the Minots," lie off the south-eastern *chop* of Boston bay, about seventeen miles from the city, and something less than eight miles from the Boston light.

These rocks or ledges, with others in their immediate vicinity, are known as the "Cohasset Rocks," and have been the terror of mariners for a long period of years; they have been, probably, the cause of a greater number of wrecks than any other reefs or ledges upon the coast, lying, as they do, at the very entrance to the second city of the United States in point of tonnage, and, consequently, where vessels are continually passing and repassing. The Minots are sunken, and bare only at one quarter flood, and the trend of the coast in that direction from Boston bay being south-easterly, vessels bound in, with the wind heavy at north-east, are liable, if they fall to leeward of Boston light, to be driven upon these rocks.

As evidence of the great necessity of a light at these dangerous rocks, I

have in my possession, from a reliable source, a statement of the number of vessels, with their names and tonnage, which have struck upon the Cohasset rocks within the last thirty years, but mostly, as my informant remarks, within the last fifteen years, to wit: ships, 10; brigs, 14; schooners, 16; sloops, 3; total, 43. Of these, 27 were a total loss. From all this, it may be clearly inferred that it became necessary that these hidden dangers should be pointed out to the seaman, and, instead of the fatal breaker to give him the first warning of his approach to danger, that there should be a friendly beacon erected upon the rock, to guide him in the storm, and enable him to avoid the horrors of shipwreck; and these, doubtless, were the considerations which led to the enactment of the law for building the lighthouse in question.

The rock selected for the site of the lighthouse is called the "Outer Minot," and lies farther seaward than others in the group known as the Cohasset rocks. At extreme low water, an area of about thirty feet in diameter is exposed, and the highest point in the rock is about three and a half feet above the line of low water. It is very rare, however, that a surface greater than twenty-five feet in diameter is left bare by the sea. The rock is granite, with vertical seams of trap rising through it.

From observations upon the tides, made at Boston lighthouse by the coast survey, from June 7th to October 27th, 1847, the following results were obtained, and, by the kind permission of the superintendent, communicated to me, together with a tracing of the coast from Boston light to Scituate light:

Rise of highest tide, - - -	14 feet 7 inches.
Mean rise and fall of tides, - -	9 " 4 "
" " " spring tides, -	10 " 8 "
" " " neap " - -	8 " 3 "

The form of the lighthouse frame is an octagon, of 25 feet diameter at base. The structure is formed of eight heavy wrought iron piles or shafts, placed at equal distances from each other, with one also at the centre.—These piles were forged in two pieces each, and are connected together by very stout cast iron or gun metal sockets, the interior of which is bored, and the pile ends are turned and secured to the sockets by means of large steel keys passing through the piles and the sockets. Above and below the joints or sockets, and connecting the middle pile with each outer pile, there extends a series of wrought iron braces; and the outer shafts are connected together by similar braces, extending from one to the other, and thus the whole structure is tied together. At each of the angular points in the octagon, and at the centre, a hole of twelve inches in diameter and five feet in depth, is drilled in the rock; the outer holes with the inclination or batter given to the outer piles, and the middle hole vertical.

The surface of the rock being irregular in shape, and the holes in each case five feet deep, it is evident that the piles must be of unequal lengths. The least length in the lower series is thirty-five and a quarter feet; the greatest is thirty-eight and three-quarters feet, and the others are of various lengths between them. The piles in the upper series are of uniform length, viz., twenty-five feet each; the inclination or batter of the piles towards the centre, is such as to bring the heads of the upper piles within the periphery of a circle of fourteen feet diameter, and there, at an elevation of sixty feet

above the base of the middle pile, or fifty-five feet above the highest point of the rock, the pile heads are secured to a heavy casting or cap, to the arms of which they are securely keyed and bolted. The middle shaft is eight inches in diameter at foot, and six inches at top, and the outer shafts are eight inches at foot, and four and a half inches at top. All of these are forged ten inches in diameter at the point where they leave the surface of the rock, and taper uniformly down to eight inches diameter in both directions, within a distance of five feet. The lower braces, placed nineteen feet above the rock, are three and a half inches in diameter; the second series, nineteen and a half feet above the first, or thirty-eight and a half feet above the rock, are three inches diameter, and a third series, introduced eight and a quarter feet below the cast iron cap, to form the support of the floor of the store-room, is made of two and a half inch square iron.

The outer piles being inclined towards the centre, and the piles and the braces being inflexible, it is clear that, so long as the braces remain in place, the pile cannot be withdrawn from the hole, for the whole structure acts as an immense "luvis;" either the braces must be ruptured, or the rock itself must yield, before a pile can be displaced.

Upon the pile heads are cast iron sockets, furnished with arms three feet in length, pointing outwards. These sockets are keyed to the heads of the piles, and are bolted to the arms of the cap or spider, flush with its upper surface; thus giving a diameter at top of 20 feet from out to out. The object of the arms is to afford support for a footway or gallery outside of the keeper's house, which is placed immediately on the cap, and there secured by bolts and keys.

The keeper's house is octagonal in shape, and 14 feet in diameter; the uprights or stanchions are of cast iron, and rest upon the cap immediately over the pile-heads, where they are secured with bolts and keys; these uprights are cast with double flanches, between which two inch plank, tongued and grooved, are to be fitted horizontally, and at right angles to these another series of plank is to be set on end or vertically, and, together, these form the side or frame of the house; upon this frame the roof will be placed, and, finally, upon this the lantern will be set up.

The drilling of the holes in the rock for the lighthouse occupied the better part of two seasons. The erection of the iron structure in place, it may be conceived, was comparatively a work of much less difficulty, and, with favorable weather, an undertaking requiring not much time. That some of the difficulties may be known of working down 9 holes of 12 inches diameter and 5 feet in depth, in a rock of granite traversed by veins of the most obstinate trap, in a situation exposed to the delays produced by every breeze which had *east* in it, I will enumerate briefly, from the journal of operations kept at the rock, some of the details, for future reference.

Early in April, 1847, I invited Mr. Benjamin Pomeroy, the contractor, who had in 1843 erected for me the Black Rock beacon, in Long Island sound, (a structure built upon the same principle that the Minot Rock light is built upon,) to accompany me to Cohasset, with the view of inducing him to undertake the drilling of the holes by contract, and also to take the piles, braces, and cap, at Messrs. Alger & Co.'s, South Boston,

where the work was to be executed, and to erect them in place at the Minot. After waiting eight days at Cohasset for a favorable opportunity to examine the rock, we effected a landing, and, with the advantages of a smooth sea and a very low tide, made sufficient measurements to determine the probable area of sound rock which might be relied upon for the base of the proposed lighthouse.

The proposition made by Mr. Pomeroy, to drill the holes in the rock for the reception of the piles for the lighthouse, I considered too high, and consequently I declined it, and sought elsewhere for a competent individual to undertake the work. After advertising in the newspapers, I received proposals from Mr. James Savage, and entered into an agreement with him to drill the holes, but after some weeks' delay Mr. Savage abandoned the contract; I then recommended, and was authorized to accept, the proposals of Mr. Pomeroy, and he undertook the work at once, but by the failure of the first contractor, the greater part of the best portion of the season, 1847, was lost, and it was not until July 22, that the new contractor, Mr. Pomeroy, actually commenced work upon the rock.

The mode of working the holes down had for some time occupied the thoughts of the contractor, and he became satisfied that holes of the magnitude required in that exposed situation, where the sea was so continually breaking over the rock, could be drilled by machinery only, and that it would be necessary to have that machinery elevated beyond the ordinary reach of the sea.

The drill used was of a peculiar form, with an edge in shape somewhat similar to the letter z, made of the best cast steel, and fitted to an iron shaft some 30 feet in length, and weighing, with the drill attached, about 600 pounds.

The machine for working the drill was a wheel and axle, furnished with tooth and pinion, and a crank or windlass at each end; this was placed on a frame of stout oak, and it required the power of four men to work it effectively. A cam and a fly wheel were attached to the axle, and at every revolution the drill was raised about eight inches, and driven ordinarily at the rate of about fifty strokes per minute, the men being relieved every twenty minutes.

To support this machine, it was necessary to erect upon the rock a triangle or shears of very heavy spars secured at their feet by means of pintles, and chained down to Lewis bolts inserted in the rock; upon the triangle was placed a platform, and upon this the machine was worked, the drill being kept at the proper degree of inclination for the hole by means of guides, through which the shaft moved up and down. The whole arrangement answered the purpose admirably well, and the holes were cut as truly and as perfectly as an auger hole could be cut in a piece of wood.

The triangle and drilling machine were swept from the rock twice by the sea during the first season's operations, and the men were frequently washed from the rock, but happily no lives have been lost. The work was suspended at the rock on the 25th October, 1847, and by reference to the journal of operations, noted carefully day by day, it will be seen how short a space of time can be reckoned upon for work in a situation so exposed.

In the report of the contractor of the 8th November, 1847, accompanying the journal of operations for that season, is the following remark:

"It will be seen by my journal, that from the 22d July to the 25th October, I was able to land on the rock, to do work, only 25 days, viz., 5 days in July, 13 in August, 7 in September, and none in October. The whole number of hours we did actually work on the rock was only 120 hours, of which 53 were from the triangle, when we could not stand on the rock to work."

The total number of men employed in 1847 by the contractor was 34, the average number about 21; in addition, a schooner of about 80 tons burthen was chartered by the contractor, for himself and his hands to live on board of, and the vessel was kept moored near the rock at all times when she could lie there in safety, or when the weather would admit of it; by this arrangement every hour of time, in which work could be done at the rock, was rendered available.

All the necessary preparations for the work of the present season were made early in the spring; a new triangle was provided of heavy spars, some forty-five feet in length, and strengthened by a number of very stout iron braces, and with bars of iron on each spar, extending over all that part of the triangle which was exposed to the shock of the sea; a vessel and hands were employed by the contractor, but no work upon the rock was effected until the 18th, 19th, and 20th May, and from that period until the 3d and 5th of June nothing was done, the weather and sea preventing even a landing. Between the 14th and 29th of June, the sea generally was smoother, still there were several of the intervening days on which little or nothing could be done; from 29th June to 19th July, but three landings were made, and at these times the sea ran so high there was but little work accomplished.

On the 21st July, this remark is found in the journal: "To-day and yesterday worth more for work on rock than last four weeks."

The holes were all finished on the 16th August: that is to say, 9 holes of 12 inches diameter, and 5 feet deep each.

Some delay was produced in this stage of the work, by an alteration which I had decided some time earlier in the season to make, to wit: to increase both the size and the length of the lower series of piles, and this increase in dimensions produced some delay in the forging at the machine shop. The difference in size between piles of hammered iron 25 feet long and 8 inches diameter, as originally designed, and piles 35 feet long and increased to 10 inches diameter, the size ultimately adopted, involved some difficulties, and required a little more time in the fabrication than I had reckoned upon, so that it was not until the 2d September that 6 piles of the lower series were forged.

On the 4th and 5th September, these 6 piles were erected in place, and, by the 21st, the three remaining lower piles had been placed, and three of the braces belonging to that series placed also.

From the 21st September until the 7th October, no landing could be effected upon the rock. On that day, the middle pile of the upper series was placed in its position; on the 10th October, two more were put up; on the 12th, five more; and on the 16th, the last pile of the upper series was set in its place. On the 26th October, the cap or spider, a casting to rest

upon the heads of the piles, to receive the dwelling house of the keeper and the lantern, consisting of eight arms and weighing some five tons, was hoisted partially towards its place; and, on the 30th October, this difficult undertaking was successfully completed, and the spider fixed in its proper position and secured there, at an elevation of fifty-five feet above the top of the rock.

The Boston light being a revolving light, the Minot, being next in order upon the coast, should be a fixed light; accordingly the apparatus ordered is of that character, and is composed of fifteen brass lamps, with reflectors of 21 inches diameter in the clear, with very heavy plating of silver, and of the best description of work.

The framing of the lantern is of wrought iron, and is a polygon of sixteen faces; diameter at the angles eleven feet six inches; height six feet six inches, furnished with cast iron ventilator; the glass, French plate, forty-four inches by twenty-four inches, and three-eighths of an inch thick; the extent of the illumination will be two hundred and ten degrees.

Thus it will be seen that the entire height of the structure from the surface of the rock to the top of the lantern, will be about seventy feet, and upwards of fifty feet above the line of highest water.

The weight of iron work in the shafts, braces, couplings, collars, spider or cap, and columns for keeper's house, is nearly seventy tons; of this upwards of forty tons is wrought iron, and the residue of cast iron; the average weight of each complete shaft is about 8200 pounds; the cast iron couplings for connecting the upper shafts with the lower are three feet long and weigh nearly 800 pounds each; they are made of the best gun metal. The weight of the lantern and illuminating apparatus will be about four and a half tons. The lantern, lamps, reflectors, and other fixtures for the lighthouse, will cost four thousand five hundred dollars, as will appear by the detailed estimates of same, rendered on the 24th ultimo.

Below the keeper's house, and enclosed within the pile heads, a species of cellar or store-room, of the size of the house, is to be built, to contain oil, fuel, provisions, &c. I had hoped last season, that all this might have been accomplished before the boisterous weather of the present year came on, and the light brought into use this winter; but this has not been practicable, as the journal of operations will clearly prove.

On the other hand, it may be considered not unwise to allow the skeleton structure to stand through one winter exposed to the fury of the sea, before the lighthouse is fitted up with its illuminating apparatus, and before it is occupied by a keeper.

Very respectfully, sir, your obedient servant,

W. H. Swift,
Captain, Topographical Engineers.

Col. J. J. Abert,
Chief, Topographical Engineers.

On the Strength of Materials as Applicable to the Construction of Cast or Wrought Iron Bridges.—"*On the Transverse or Cross Strain.*" *By* GEORGE BUCHANAN, ESQ.

Continued from Vol. XVI, page 158.

The President stated that he proposed now to complete the third branch of the subject—namely, the TRANSVERSE STRENGTH OF MATERIALS, but would first advert to one or two points connected with the preceding expositions, namely:—

First, The Conway Tubular Bridge, in regard to which it was gratifying to observe, that it had now been in operation for upwards of three months, the regular traffic of the line going on, and trains passing and repassing daily, everything connected with it proceeding in the most satisfactory manner, and this truly wonderful design crowned with complete success. He then exhibited a drawing of the great Britannia Bridge, now in progress of erection across the Straits of Menai. This was exactly on the same principle as the Conway Bridge, but on a still more magnificent scale, the Straits here being so much wider, and the bridge, in order to keep the navigation free from obstruction, being elevated 102 feet above the surface of the water at the highest equinoctial tides. The breadth across the Straits at high water is about 1160 feet; and, including the banks to the abutment piers of the bridge, 1490 feet. This space is divided into four spans by a massive pier in the centre of the water way, termed the Britannia Tower, 45½ feet thick, and two small piers or towers in the water at each side, 32 feet each, forming two spans in the centre, 460 feet in length each, and two half spans, one on each side, 230 feet.

Secondly, Having been particularly requested by the Society, at the last meeting on this subject, to extend and complete his experiments on the tensile and compressive strengths of different stones, he would now state the result of these experiments. The mode of trying the direct *tensile strength* was formerly exhibited by appending weights to the substance till it was actually torn asunder. In this way the strength of the different stones, by careful and repeated experiments, was found at an average as follows, viz:—

	Breaking Weight.
Craigleith stone,	453 lbs.
Hailes,	336
Redhall,	326
Humbie,	283
Binnie,	279

Several other specimens had been prepared of marble, whinstone, Caithness and Arbroath pavement, and the results on these would be afterwards communicated.

The *compressive strength* of these substances, or their power to resist crushing, being generally far beyond their tensile strength, could only be tried conveniently by mechanical power, and he showed the apparatus which had been used for the purpose, consisting of a combination of two

levers, giving an increase of power of 30 to 1. The specimens, consisting of nearly exact cubic inches of the material, being placed near the centre of motion, and the upper lever brought down with a plate of metal to fall exactly on the stone, the weights were applied at the extreme end of the lower lever until the stone gave way. On trying, at the meeting, with this apparatus, a piece of Hailes stone, it bore 3540 lbs., and then gave way with a violent crash. A specimen of Craigleith stone was next tried, the side of the cube being about one-eighth part more than a square inch. This carried upwards of 6500 lbs., when the sides began to skirt off, and with 6810 lbs. it suddenly gave way, and was crushed to powder. In all these experiments it was observed that when any part of the stone remained entire, it exhibited the same appearance noticed by Hodgkinson in the fracture of cast iron; pieces breaking off at the sides at certain angles, and leaving a nucleus of a conical shape. Specimens of these were preserved, and may be shown at another meeting. By experiments of this kind, carefully made and repeated, he had found the *compressive strength* of the different stones as follows:—

Craigleith, gave way to a pressure of	4900 lbs.
Humbie, - - - -	3740
Hailes, - - - - -	3530
Redhall, - - -	3320
Binnie, - - - - -	2820

In regard now to the *transverse strain*, this, as formerly explained, is of a compound nature, both the tensile and compressive forces being brought into play. A beam supported at the one extremity, and loaded at the other, becomes a lever, at the extreme end of which acts the weight tending to bend and break the material, by turning it round the point of support; while the power of resistance, residing in the section of fracture at the support, acts in the middle of that section, and at a distance from the centre of motion equal only to half the depth of the beam. The same is the case with a beam supported at the two extremities and loaded in the middle; the beam, in that case, dividing itself in the centre into two levers, and half the weight acting at the extremity of each; while the strength of the beam acts, as before, in the centre of resistance, which is in the middle section of the beam. The notion of the beam turning round the point of support, and distending or stretching all the particles in the section of fracture, which was that of Galileo, is not correct; the centre of rotation is in a point somewhere near the middle of the beam, and all the particles below this point are distended, while all the particles above this point are compressed or crushed together, while in the centre they are neither compressed nor distended, and hence this point has been termed the neutral axis.

Much discussion has arisen regarding the exact position of this neutral axis—the limit between the tensile and compressive forces—a nice question, and one of abstruse and difficult investigation; and the probability is, after all, that it is not a fixed point, but is liable to vary with the nature and intensity of the strains. Be that as it may, it fortunately happens that the practical result as to the strength of the beam is almost exactly the same, whether the axis be supposed, with Galileo, at the point of support,

or, with succeeding philosophers, at a point near the centre. In every case the strength depends, as formerly explained, on the length and depth of the beam, combined with its area at the section of fracture; and by these three elements the strength can be calculated in every case, provided we ascertain by experiment the actual strength of a beam or beams of given dimensions. Numerous experiments have been made with this view, and particularly on cast iron, by Messrs. Hodgkinson and Fairbairn, and other observers. These were made on beams of various dimensions as to length, breadth, and thickness, but the calculation is simplified if we reduce them all to a unit or standard of 1 cubic inch; taking, for example, a bar 1 inch square, resting on supports 1 inch apart and loaded in the middle, and the average result of all the different experiments is, that such a bar of cast iron would bear a weight of 24,400 lbs., or very nearly 11 tons. The strongest specimen was of No. 3, cold blast, which gave 31,212 lbs., or nearly 14 tons; and the weakest being one of No. 2, hot blast, gave only 19,278 lbs., or better than 8½ tons. The difference as to strength between the hot and cold blast appears to be trifling. The following are the strengths of some of the irons, given by Mr. Hodgkinson:—

Carron, No. 3, hot blast,	12·7 tons.
Do. do. cold blast,	10·9
Do. No. 2, hot blast,	11·1
Do. do. cold blast,	11·5
Low Moor, No. 2, cold blast,	11·4
Muirkirk, No. 1, hot blast,	10·1
Buffery, No. 1, hot blast,	10·5

Every other beam, then, will bear in this average proportion of 11 tons, in respect of the three elements above mentioned—namely, 1st, the section of fracture; 2d, the depth of the beam; and, 3d, the length or distance between the supports; and the rule is, to multiply this average unit of strength of 11 tons, 1st, by the section of fracture; 2d, by the depth; and, 3dly, divide the product by the length. This is a universal rule, and one of most extensive application, and is here given in a somewhat simpler form than is generally found in elementary works. He then showed the effect, by experiment, on a cast iron beam, one inch square, supported at the extremities at two feet apart, and loaded in the middle till it broke. By the above calculation of 11 tons for the unit, the strength would be 1068 lbs.; and it first deflected greatly, and then broke, all of a sudden, with a weight of 1140 lb.; and as the exact area of the bar is about $\frac{1}{10}$th more than an inch, this gives a unit of strength very nearly that of the average above mentioned. This specimen of iron was from Broughton Foundry, and he understood was of Summerlee iron, No. 2.

Form of the Beam.—The simple rectangular beam is not the one best fitted for strength in proportion to the weight of material employed. In the first place, the centre being the weak point, the mass at the ends may be reduced and accumulated in the centre, giving the beam a curved shape on the upper or under, or on both sides; and this is the form generally adopted in large beams or girders. The ends may be safely reduced to half or two-thirds of the depth in the middle; and for a load uniformly distributed over the beam, the surface should be formed to an elliptic curve,

and for a load at the centre, to a parabolic curve. But, 2dly, the cross section of the beam, instead of being rectangular, can be modified with great advantage by removing the material from the central parts, and accumulating it, in the form of projections or flanches, either at the top or bottom, or both. If the flanch be at the top, the cross section or the figure of the beam looking endways is that of the letter T; and if the flanch be at the top and bottom, the figure is that of the letter I, with the head and tail extended. Originally the T form, with the head or flanch downmost, was adopted in large manufactories or buildings for carrying brick arches, chiefly for the convenience of obtaining a bearing from which the arches on each side might be sprung. Afterwards the I or double T form was recommended, on no less an authority than Tredgold.

But the knowledge and consideration of the property of cast iron, already described, in possessing a compressive strength much superior to the tensile, has given an entirely new view to the subject, and led to very important practical results. This is a discovery due to Mr. Hodgkinson, and the experiments and investigations which he has undertaken, in conjunction with Mr. Fairbairn, have rendered most essential service in this branch of practical mechanics. The upper part of the beam being compressed by the application of a weight, and the under part distended, and the tensile resistance being three or four times less than the compressive, it is evident that the material of the beam ought to be accumulated much more at the bottom than at the top; and in order to ascertain practically how far this principle might be carried, Mr. Hodgkinson made a variety of trials of different forms, beginning with the flanches equal at top and bottom, or the letter I form, then increasing the bottom flanch by ten or twelve different steps, till he found at last the greatest strength was attained when the bottom flanch (as in this figure ⊥) was six times greater than the top; and some very curious results arose from these investigations.—The strength of the beams, formed according to these views, is easily calculated on the principle already explained; for, whatever be the form, it will be found that the strength is still very nearly proportional to the three elements—length, depth, and section of fracture; but the unit of strength or standard for each beam is different. For rectangular beams of cast iron, this unit, as explained, is at an average 11 tons. For the equal flanch beam, which was formerly considered a model, the unit is no greater, but rather, if anything, less; but when the bottom flanch is increased beyond the top in the ratio of $4\frac{1}{2}$ to 1, the unit of strength of every inch of the beam is increased to fifteen tons; and when the bottom flanch is farther increased in the ratio of 6 to 1, the strength is increased to nineteen tons. He then showed by experiment the strength of a cast iron beam 2 feet by 2 inches deep, bottom flanch five times greater than the top, and area of fracture 1 inch. If rectangular, it should have broke with 2280 lbs., but it carried 3750 lbs., and then gave way, showing an increase of strength equal to 1470 lbs., gained by this form of the section.

Since these experiments of Mr. Hodgkinson, others have been lately made by Bramah and others, particularly those under the sanction of government, in reference to the fall of the cotton mill at Oldham, by Sir Henry de la Beche and Mr. Thomas Cubitt. These are important, as being made on a larger scale than the others. They entirely confirm the

views and results of Hodgkinson, but the beams experimented on not being of the same forms, do not give the same degree of strength. On the whole, therefore, the results given above may be relied on; but the strains for perfect security ought on no account to be carried beyond one-fourth or one-third of the breaking weight.

Now that the nature of the transverse strain has been so thoroughly investigated, an important consideration arises,—how far improvements may not still be made by the introduction of malleable iron in conjunction with cast iron, so as to form beams of a compound nature, having all the parts liable to compression of cast iron, and all the parts liable to tension of malleable iron. This has already been adopted, in some cases with success, by the introduction of what are called tension-rods of malleable iron; but it is extremely doubtful if the best combination of the two metals has yet been ascertained. The great point is to keep the two metals clearly and distinctly to their different offices of resisting compression and tension, and unless this be done there is difficulty and risk of bringing the one or other of them into action, and neither of them, in such cases, sustaining its proper share of the load or pressure, the most serious consequences may result from the combination. Owing to this, the use of tension-rods has been rather condemned by engineers, and not without reason; but Mr. Buchanan thought the objections were not so much to the use of the tension-rods, as to the injudicious manner in which they have been or may be applied.—No general rule, he said, could be laid down, but one principle should never be lost sight of—that the strongest form is the simple one of the roof; the two rafters butting against each other at the top producing a simple compressive strain through their length, and at the bottom a horizontal thrust on the extremities of the tie or tension-rod, producing simple distension. Forms might require to be modified by circumstances, but to this they ought all to tend, as to a centre involving the most perfect distribution of the forces. He then gave several illustrations of the mode of applying these ties, pointing out where they would be of essential service, and where they would be objectionable and inefficient.

In many cases of railway bridges, the space between the level of the railway on the one hand, and sometimes a road, sometimes a stream, or navigable river, on the other, is so confined, that even with tension-rods well applied, or massive girders, the span is so great as to occasion too enormous a strain to be safe or expedient; it is much better in such cases, rather than attempt to span the opening with too limited a depth of beam or girder, to acquire height by setting the girders on the outside of the railway, where an unlimited height can be obtained for arching, or framework of timber or iron; and this leads to the consideration of a remarkable species of bridge much in use in crossing the vast openings of the American rivers, both for common roads and railways. It is termed the *Frame Bridge* or *Lattice Bridge*. These bridges have been most extensively applied, and with complete success, and, by successive improvements, have now been brought to great perfection; and as they possess some remarkable properties, and form an excellent illustration of the principle of dividing the tensile and compressive strain into distinct members of the bridge, he thought it might not be uninteresting to the Society, to give a short explanation of them here.

A very interesting account of these bridges, one of which, over the Susquehanna at Columbia, of twenty-nine arches, each of 200 feet space, is about a mile and a quarter in length, will be found in Mr. Stevenson's excellent work on the "Civil Engineering of North America," and through two engineering friends he had been favored with farther information and drawings, which were exhibited.*

The great principle of the frame bridge he then illustrated by reference to a small model. It is nothing but a simple modification of the principle of the roof; two rafters meeting in the centre of the bridge, and resting at their extremities on a tie-beam; from this centre the tie-beam is extended longitudinally on each side, and running horizontally to the opposite abutments; and along with it, at regular intervals, a series of rafters, running parallel with each other and parallel with the centre one, are extended the whole length of the bridge; the feet of these rafters rest on the tie-beam; the tops of them cannot meet, but are connected by an upper longitudinal beam running horizontally. On this the rafters are all abutted, and act exactly as if each pair had met in the centre, only that the intermediate connecting beam is subjected to a compressive strain, arising from these rafters all pushing on towards the centre, in the same manner as the lower beam is subjected to a tensile strain from all the feet of the rafters pushing off from the centre. The upper beam is termed the top chord, the lower beam the bottom chord, and the rafters are called the braces; and one member more is only wanted to make the structure complete—namely, a beam or tie standing vertically, to connect the top of the one rafter with the foot of the next adjacent, towards the centre; and in this manner every part of of the frame is supported, and there being no cross strains whatever, it is truly astonishing how much such a structure will bear. The last-mentioned beam, from being subject to the tensile strain, is termed the tie, and a great improvement has been effected by the introduction of malleable iron rods in place of timber; by means of this, and of screws and nuts, the whole structure can be brought to a perfect degree of tension, so that every joint and member may bear its due share of the load, and in the case of shrinkage of the timber, or other derangement, the equilibrium and perfect form of the structure can easily be restored and maintained. By screwing up the ties in this manner, the bridge tends to assume an arched form, rising with a camber in the middle; to prevent this, another member has been introduced, termed the counter-brace, which is a beam of timber, extending from the top of one rafter to the bottom of the next adjacent, from the centre towards the extremities of the bridge. This counter-brace crosses the braces and resists any change of form which the screwing-up of the rods would bring on; and there is this remarkable advantage obtained, that the action of these counter-braces, thus screwed up to a certain degree of tension, prevents the weight of the passing loads from having any effect in straining or deflecting the bridge. Instead of any additional strain on any part, these loads rather relieve the counter-braces from the tension to which they are subjected. No deflection or change of form can occur, except

* For one of these drawings he was indebted to his old friend and assistant, Mr. Laurie, now engineer on some of the American Railways; and for the other, along with interesting views as to the principles of construction, to Mr. Lawson, a friend and engineer, lately returned to Britain.

what may arise from the mere compression or distension of the parts, and these being all strained endways, and there being no cross or oblique action, this effect is absolutely nothing; and the form of the structure and the strains on it become in a great measure, if not entirely, independent of the fluctuating traffic. The bridge is already strained to the utmost extent of any passing load, and cannot be affected by it; whence arises a principle of stability and safety, well worthy of consideration, particularly in the case of railways.

The strength and stiffness of the small model was then shown, and the enormous load which it carried; and the whole of this interesting subject was concluded by the exhibition of a much larger model of one of the American bridges. Bridges of so great a span as 200 feet are common enough in that country, and the model represented one of these. It was exactly $\frac{1}{10}$th of the dimensions, being 20 feet long, and the frames on each side 2 feet deep, consisting of the top and bottom chord, 1 in. by 2½ inches; the braces in pairs ¾ of an inch square; the tie-rods in pairs ¼-inch diameter and the counter-braces each single, ¾-inch square. One of these frames was placed at each side of the bridge, connected at the bottom by cross beams, on which was laid the planking of the roadway. The whole weight of the bridge was only 113 lbs., and although 20 feet span and of such slender materials, it carried six persons, equal to at least 7 or 8 cwt., standing on the centre, without deflecting more than ¼ of an inch.

Another advantage he also mentioned of these bridges was the simplicity of construction; the braces and counter-braces were all cut exactly to the same length and square on the ends; no mortising or jointing of any kind, but resting simply on blocks attached to the top and bottom chords, through which blocks were also passed the tie-rods. Nothing could be simpler, and the whole bridge could be taken down, removed to another site, and there put up with facility. It is easy to see also, that as the malleable iron ties have been substituted for the upright timbers, so may it be for the bottom chord; and the braces and counter-braces could be made of cast iron in the form of hollow square tubes, which would altogether form an extremely simple and strong girder or bridge. One remark, however, he must make regarding all these bridges or girders of a rectangular form—namely, that though they may be practically convenient in many respects, they are all attended with a sacrifice of material, in so far as they deviate from the principle of the arch. The top chord might be in the form of an arch, starting from the level of the roadway at the abutments, and rising to the original height at the centre. In this way much material would be saved, while the strain on the chord would be greatly less, owing to the curvature; and this form is often used in America, but not combined with the principle of the braces and counter-braces as it might be. The same remark applies also to the iron tubular bridges, which possess advantages in simplicity and great steadiness, but no doubt the material at the ends is redundant, and the strain in the centre beyond what would occur in the case of the arch. He now begged to conclude these expositions, which had been extended to much greater length than he had anticipated.

After the reading of the paper, Professor Forbes observed, that in regard to these American bridges, which appeared to possess peculiar properties,

he would put a question or two which Mr. Buchanan might probably answer—namely, how far they did not resemble in principle the iron tubular bridges of Mr. Stephenson. The frame-work in the model of the American bridge at the sides was no doubt open, but he observed from the drawing that there were double the number of frames as there were in the model. and he understood that the sides were often formed by numerous little lozenges, or lattice-work, forming nearly a continuous web, and he should like to know whether the sides of the tubular bridge, with the angle-irons to strengthen them, did not much resemble this web of lattice-work. In regard to the top and bottom also, it appeared from the model that those also were united by diagonal beams or frames, forming a sort of enclosure at top and bottom, and as the side frames were twenty feet in height, this left ample head-room for passengers and carriages.

Mr. Buchanan could not help expressing how much he felt gratified by the countenance and approval of such high authority as Professor Forbes. In regard to the American bridges, the resemblance in principle to the tubular bridges had struck himself forcibly in considering these structures. The top and bottom chords of the former, answered to the cellular tubes in the roof and floor of the latter, and the frames on each side to the iron plates, forming the sides of the main tube, with their numerous angle-iron pieces, which were laid on the continuous ground of the plates to give stiffness to the sides. The frames of the American bridges were also connected at the bottom by cross frames and timber planking; and at the top, he believed, they were also, in some cases, connected in a similar manner, and covered in by a roof, for protection against the weather; so as, on the whole, to form, as it were, a complete rectangular tube in skeleton. Still, however, the tubular bridge was, in many respects, a very different structure; and the design of a bridge, of one vast malleable iron tube, was an idea at once happy and original, and was, he considered, due entirely to Mr. Stephenson.

Mr. Buchanan having explained, in regard to the tensile strength of malleable iron, stated at 27 tons for the breaking weight, that this was from the old experiments of Telford, Brown, and Rennie, Professor Forbes said he understood from Mr. Stephenson that he considered this result too high. Mr. Buchanan stated that he was not aware of this, but he knew Mr. Stephenson had taken the safe load of malleable iron of the Tyne bridge at 9 tons, which was rather larger than Mr. B. had been used to calculate, so that the final results were very nearly the same. He would, however, endeavor to obtain Mr. Stephenson's results accurately.—*Proc. Roy. Scot. Soc. of Arts.* Civ. Eng. & Arch. Jour., Jan. 1849.

Extracts from the Twentieth Annual Report of the Mine Hill and Schuylkill Haven Railroad Company, January 8th, 1849.

The quantity of coal furnished to the road from this district, (Tremont,) instead of being one hundred thousand tons, as was confidently anticipated by the parties for whose accommodation the road was projected, has reached only the small amount of thirty-six thousand and thirty-three tons $\frac{3}{20}$. The other branches of the road have contributed to our trade in the following

proportions. Wolf Creek, one hundred and ninety-nine thousand six hundred and nineteen $\frac{6}{20}$ tons. West Branch and Main Stem, one hundred and sixty-nine thousand three hundred and seventy $\frac{7}{20}$ tons. West West-Branch, one hundred and forty-three thousand one hundred and forty-eight $\frac{12}{20}$ tons. Muddy Branch, fifty-two thousand five hundred and sixty-four $\frac{6}{20}$ tons. The miscellaneous tonnage other than coal, is eight thousand five hundred and ninety-four $\frac{4}{20}$ tons; making the net tonnage of the whole road, as exhibited by the returns of the Collector, six hundred and nine thousand three hundred and thirty $\frac{5}{20}$ tons, exceeding that of the previous year by twenty-five thousand seven hundred and thirty-nine tons. The tolls charged for the use of the road, and for the motive power, &c., amount to one hundred and forty-four thousand one hundred and twenty-three dollars and seventy-nine cents.

The aggregate net tonnage that has passed the Company's scales since the opening of the road, is four millions and eighty-eight thousand and twenty-six $\frac{15}{20}$ tons; in addition to which, two hundred and fifty-seven thousand tons have been carried over the road free of toll. In compliance with the wishes of the inhabitants of several towns on the line of the roads, arrangements were made for a passenger train to run from Schuylkill Haven to Minersville and Tremont, making two trips daily to the former, and one to the latter place.

Net tonnage of coal and miscellaneous freight transported during the years,

	Tons of 2240 lbs.
1831,	17,559·00
1832,	65,420·00
1833,	77,072·00
1834,	42,616·00
1835,	66,130·00
1836,	107,845·00
1837,	170,230·00
1838,	142,485·00
1839,	150,919·00
1840,	171,409·00
1841,	238,180·00
1842,	195,014·00
1843,	257,012·00
1844,	312,718·00
1845,	410,592·10
1846,	469,904·07
1847,	583,590·13
1848,	609,330·05
Total net tonnage,	4,088,026·15
Add am't of disc't ranging from 5 to 7½ pr. ct.	257,173·00
Whole tonnage,	4,345,199·15

Duty performed by engines in 1848.

No. of engine.	Builders.	Cars hauled.	Tons of coal.	Miles traveled.
1,	M. W. Baldwin,	15,223	67,113	8,515
2,	"	16,913	75,038	8,000
3,	"	20,158	88,243	10,024
4,	Norris, Brothers,	10,446	45,956	5,751
5,	"	14,168	63,573	11,703
6,	"	14,432	63,739	7,389
7,	M. W. Baldwin,	19,540	84,877	9,827
8,	"	13,234	57,870	6,194
9,	Norris, Brothers,	12,293	54,327	6,160
	Total,	136,407	600,736	73,563

The 10th engine, "Middletown," is of small class, built by M. W. Baldwin, and has been used only for trucking and drawing passenger car.

AMERICAN PATENTS.

List of American Patents which issued in the month of March, 1848, *with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents, in the U. S. Patent Office.*

1. For an *Improvement in Horse Collar Blocks;* Ansel Benham, Belvidere, Boone county, Illinois, March 8.

The patentee says,—"The nature of my invention consists in a peculiar manner of constructing an inclined extension swivel board, sustained upon an inclined bench resting upon four legs, to which board the collar is fastened at the middle and ends, in any convenient way, whilst being stuffed at one end, the board being swiveled round, or turned end for end, in order to stuff the opposite end, the collar being subsequently blocked and formed on the block; being an improvement on the mode patented by Wade Haworth in 1845."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of constructing the extension stuffing board, and of operating the same for the purposes set forth: that is to say, I claim the combination of the sliding section of the stuffing board with the turning section and strap and windlass, the sliding section being made with a tongue, and the turning section with a mortise, within which the tongue slides back and forth in extending and contracting the same."

2. For an *Improvement in Harness Buckles;* James Howey, New Pittsburg, Wayne county, Ohio, March 8.

The patentee says,—"This buckle is made of a piece of plate brass, or other suitable metal, it being formed into a parallelogram tube, agreeable to suit the place it is intended to occupy. It is formed so that the ends of

the plate pass each other, and are laid together enough to make one side of the tube a double plate, of the tube is the hole made for the purpose of receiving the tongue. This tongue is made of brass wire or other suitable material, it being made smaller at the end of the tongue, which is bent and secured around the axis between the hole and nearest edge; the other end extends to the opposite side of the tube, and rests in the notch which is made in the edge of the plate for that purpose. This buckle is permanently fastened to the strap, by the strap passing through the buckle and returning back outside, so as to enclose the double part of the plate, and there made fast by stitches, it being made fast to the strap as described. The other end of the strap is prepared with holes, passed through the slides and rings, and brought back through the buckle, and the tongue passes through the hole and rests in the notch."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of a buckle as above described, for the purpose of adjusting and fastening straps."

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3. For an *Improvement in Lead Pipe Machinery;* Isaac Adams, Boston, Massachusetts, March 8.

Claim.—"What I claim as my improvement, is the combination in which the core is sustained by pressures on opposite sides of it, and the mandril: meaning to claim the said combination, whether a double cylinder and two pistons, or two or more cylinders and as many pistons, are employed in it, to act with respect to the mandril, core, and die, placed centrally between them, substantially as set forth; the said combination enabling me to entirely dispense with a bridge for supporting the core, and a construction chamber applied to said bridge, for the purpose of uniting the metal after its separation by the said bridge, and previous to its passage between the die and core. The aforesaid arrangement and combination enables me to obtain a short, substantial, and unvarying mandril; also one general and undivided passage for the pipe material to and through the die—the material in my machine being, at no time in the operation, disconnected so as to require re-uniting. It also renders unnecessary the hollow ram, which is used in some machines to keep the mandril in place."

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4. For an *Improvement in Cutting Boots;* J. A. & A. F. Jones, Lexington, Fayette county, Kentucky, March 14.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the manner of forming and cutting boot uppers of the proper shape to correspond with the various measures of the foot, by means of the board, having a line upon it corresponding to the crimped front, indicated by the series of screws, (or by raised points or a ledge,) combined with the series of graduated scales, and the indicators located in various parts of the board, in the manner set forth; which combination and arrangement of scales, line, and indicators, is applied to the formation of the boot uppers, by means of the scale draught and the form, substantially as set forth."

5. For an *Improvement in Propellers for Vessels;* J. E. Smith, City of New York, March 14.

The patentee says,—"The nature of the first part of my invention consists in combining with the paddle wheels, constructed in any desired manner, and placed at the sides of the vessel, a propeller or propellers placed at the stern of the vessel, the axis of which to be parallel (or nearly so) with the keel of the vessel, so that the vessel shall be impelled by the joint action of the propeller or propellers at the stern, and the paddle wheels at the sides; such joint action having the effect, as shown by experiment, to impel the vessel with greater velocity and more steadily, with a given force, than by the action of the paddle wheels or the propeller or propellers separately. And the second part of my invention consists in placing the paddle wheels, when used in combination with the propeller or propellers at the stern, forward of the centre of gravity of the vessel, that a portion of the action of the paddle wheels thus placed, may have the effect to partly lift the bow of the vessel, while the propeller or propellers at the stern exerts all its action to impel the vessel forward. The paddle wheels for the sides, and the propeller or propellers for the stern, may be constructed in any of the known and approved forms, as this makes no part of my invention."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is propelling vessels by the combined action of the paddle wheels at the sides of the vessel, and the propeller or propellers at the stern, substantially as set forth, whether this be done with the paddle wheels placed with their axis passing through the centre of gravity of the vessel, or forward or back of it, as described. And I also claim as my invention, placing the paddle wheels forward of a line passing transversly through the centre of gravity of the vessel, as described, when this is combined with the propeller or propellers at the stern of the vessel, as set forth."

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6. For an *Improvement in the Mode of Taking the Yeas and Nays in Legislative Bodies;* R. E. Managhan, Liverpool, Perry county, Pennsylvania, March 14.

The patentee says,—"The nature of my invention consists in obtaining the correct vote of any and all deliberative bodies by machinery, instead of the ordinary methods, by ballot, or viva voce."

Claim.—"I claim the use of indices, furnished with a point which is to perforate the paper upon which the yeas and nays are to be taken in legislative bodies, said perforations being, in the present connexion, a simple, and at the same time indelible, mode of recording the vote. I also claim using a movable frame or carriage, to which the record of votes is attached, for the purpose of enabling me to place the apparatus for recording in any suitable part of the hall, from which the carriage, with the list of yeas and nays, may be carried directly to the Speaker's table. And I also claim, in combination with the lancet or perforating indices, the manner of constructing the carriage, viz. with a perforated plate, frame, and pins, and holes, as set forth."

7. For an *Improvement in the Manufacture of Spoons;* Robert Wallace, North Haven, New Haven county, Connecticut, March 14.

Claim.—"I do not claim the strengthening of the spoon handles by the enclosing therein either a wire or flat piece of tin, or other metal, the latter mode having been used by me in years past, and found not to answer the purpose; but I do claim as my invention, and desire to secure by letters patent, the enclosing in the centre of the handle of a spoon, for the purpose of strengthening the same, a strip or piece of tin plate, or other suitable metal, in concave, grooved, or tubular shape, or in any shape whereby one or more edges of the said strip or piece will be made to resist the up and down strain of the handle, said strip or piece having been first formed or shaped by a drop in suitable dies or otherwise, and curved to suit the bend of the handle, all in manner and substantially as set forth."

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8. For an *Improvement in Refrigerators;* John S. Tough & J. T. Craddock, Baltimore, Maryland, March 14.

The patentees say,—"The nature of our invention consists in forming a chamber in connexion with the refrigerator, in which the air surrounds a vessel filled with ice water, for the purpose of reducing the temperature of the air within both the chamber and refrigerator, the communication between the two being cut off when the door of the refrigerator is opened."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is an air chamber surrounding the reservoir containing the ice and water, and connected with the refrigerator by a lattice or other opening substantially in the manner and for the purpose set forth. We also claim connecting the valve which closes the communication between the air chamber and the refrigerator with the door of the refrigerator, as described, so that the valve may be closed while the door is open, and vice versa, as herein set forth."

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9. For an *Improvement in Machinery for Dressing Combs;* Ebenezer Wilson, Redding, Fairfield county, Connecticut, March 14.

The patentee says,—"The nature of my improvement consists in the manner of holding and conveying the pieces of horn or other material to the cutters, and so constructing said cutters as to always preserve the same diameter and form of moulding during the process of sharpening, until the cutters are entirely worn out."

Claim.—"What I claim as new, and desire to secure by letters patent, is the method of holding the material to the revolving cutter without clamping, substantially as described, by enclosing said material, on all sides, by combination of the recesses formed in the carriage and table, through which the rotary cutter head projects, in the manner set forth."

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10. For an *Improvement in Manufacturing Spoons;* John Mix, Cheshire, New Haven county, Connecticut, March 14.

The patentee says,—"The nature of my invention consists in uniting and combining a handle of iron or composition metal with a bowl of britannia metal."

Claim.—"I claim as my invention, the union or combination of handles of iron or composition metal, tinned, with britannia metal bowls, in the manufacture of spoons, as set forth."

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11. For an *Improvement in Cooking Stoves;* Edward A. Butts & R. F. Stevens, Syracuse, Onondaga county, New York, March 14.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the use of a single central flue, passing through the oven and constructed as set forth. We also claim the manner described of constructing boilers for cooking stoves, viz., by the addition of an outer plate as described, for the purpose of admitting the heated air to pass upward around the sides of the boiler, and above the upper plate of the stove."

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12. For an *Improvement in Substrata for Pavements;* H. P. Russ, City of New York, March 14.

Claim.—"I claim the constructing a concrete foundation in panels or sections, (to give access to pipes and conduits below,) by the application and combination therewith of frames formed of any suitable material, with a thinner edge upwards, to allow the concrete mass to be lifted out when needed, as set forth, when this is combined with a paved roadway of any kind laid thereon as described."

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13. For an *Improvement in Harness Saddle;* A. H. Gazlay, Saratoga Springs, Saratoga county, New York, March 14.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of making the jockey skirts, as set forth: that is, making the skirts, tree, and staple, entirely of metal and of one piece, so as to dispense with the leather and stitching usually adopted, and at the same time to preserve the beauty of the saddle."

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14. For an *Improvement in Ships' Windlasses;* Charles Perley, City of New York, March 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the constructive mode of fitting the barrel with the horned cams, or flanches and ratchet wheels, conjointly with the application of the disks, pawl boxes, pawls, and lever sockets, to be used in working the barrel and flanches, for nautical and mechanical purposes, collectively, constructively, and substantially as set forth."

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15. For an *Improvement in Cooking Stoves;* R. D. Granger, Albany, New York, March 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the use of the bulk head for dividing the direct flue under the oven at the back of the fire, which bulk head may have a current of cold air passing through the interior of it, to protect it from the intense heat of the fire at that point, substantially as set forth. I do not intend to claim

the introduction of cold air through the bottom plate, but I do claim the mode of introducing it in combination with the division of the direct flue under the oven as set forth. I also claim, in combination with the bulk head, the construction of the bottom flue, and the mode of dividing the back flue behind said bulk head, as set forth. I also claim the mode of connecting the bottom plate of the oven, the back fire plate, and bulk head, as described and for the purpose set forth, so as to make the parts of one support the other at the point most liable to be injured by heat."

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16. For an *Improvement in Tuyeres;* Alex. H. Hart, Chagrin, Cayuhoga county, Ohio, March 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of a tuyere having two orifices for the escape of the blast, in combination with a revolving valve and diaphragm, so that the blast may be light or heavy through one or both of the orifices, the whole forming a bed or lap for the burning coals, as set forth."

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17. For an *Improvement in Preparing Fabrics for Printing;* John Coates, Manchester, England, March 21; (patented in England April 27, 1847.)

Claim.—"I claim the use of a cord, cylinder, and brush, as applied to the ordinary calico printing machine, for cleaning the surface of the cloth as described."

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18. For an *Improvement in the Apparatus for Turning;* Chauncey W. Case, Syracuse, Onondaga county, New York, March 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of adapting lathes to turning sticks or pieces of wood of various sizes, viz., by means of the attachment of mouth pieces to the revolving hollow mandril, by the aid of the screw joint, arranged and operating as set forth, thereby dispensing with the necessity of changing mandrils for the same purpose. I also claim the manner of holding the stick within the hollow mandril while it is being turned, viz., by means of the extension of the mouth piece within the mandril to the finishing cutter, and its opening made of the diameter mentioned."

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19. For an *Improvement in Washing Machines;* Stephen Porter, Seneca Village, Ontario county, New York, March 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination, consisting of the wrappers and eveners, and the movable roller used in passing the articles washed between the cylinders, and releasing them therefrom, as set forth. And I further claim that this security may be extended not only to the use of these wrappers and eveners, in connexion with the particular arrangement of the cylinders and rollers in the machine, but also to any other arrangement of cylinders and rollers substantially the same, when their wrappers are used in connexion with the eveners, as the means of passing clothes between rolling cylinders in the process of washing."

20. For an *Improvement in Type-Smoothing Machines;* David Bruce, Jr., Williamsburg, Kings county, New York, March 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is 1st, The combination of the alternating plate, inclined planes, pusher, and stud, made and arranged substantially as described, said plate sliding beneath the inclined plate parallel to the cutters, for the purpose of raising the stops, pin, and carrying the stud with its pusher arm, as set forth."

"2d, I claim making the inclined plate with passages through the same, for the traverse of the stems, pin, and stud, as described.

"3d, I claim the combination of the stems with the stops, said stems passing down through the inclined plate, and acted upon by the inclined planes.

"4th, I claim the combination of the latch with the cutter bar, said latch acting as a lower stop to the type, and being raised by the pusher in its traverse motion to the right and left underneath it.

"5th, I claim the combination of the piston with the inclined plane, for lifting the upper cutter, as set forth."

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21. For an *Improvement in Wool Pickers;* Edward & G. C. Kellogg, New Hartford, Litchfield county, Connecticut, March 28.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the construction of the main cylinder entirely of cast iron or other suitable metal, fitted to receive oblique segments of saw-like teeth, or oblique rows of spike teeth; said cylinder being composed of a succession of wheels or rings, placed on a common shaft or axis. And also the sectional feeder, composed of a number of gear-like spur wheels, packed together in the form of a small cylinder, and not made firm on the shaft, but having holes in their centres much larger than the shaft; so that each wheel being attached by a separate spring, may rise and fall, or approach and recede from the shell separately, so as to press and hold upon all parts of an uneven feed, while the main picking cylinder acts upon it, as described."

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22. For an *Improvement in Electrical Machines;* E. S. Blake, Allegheny City, Pennsylvania, March 28.

The patentee says,—"The characteristic of my invention consists in employing for the electric a tube or cylinder of glass, supported by a fixed rubber which surrounds it, and in which it is to be moved back and forth in the direction of its axis, in distinction from the usual method of employing a glass cylinder or disk, mounted upon gudgeons or journals, supported in a frame and revolving about its axis. By means of this device, I am enabled to reduce the several parts of the apparatus to such form that they can be made at less expense and packed in a case of smaller dimensions than the apparatus heretofore in use."

Claim.—"What I claim and desire to secure by letters patent, is the employment of a tubular or cylindrical electric, moving in the direction of its axis, in combination with a fixed rubber, embracing, supporting, and

guiding the same, and in further combination with the conducting wires; the same being constructed and operating substantially as described."

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23. For an *Improvement in Joiners' Planes;* Benjamin F. Shellabarger, Mifflintown, Juniata county, Pennsylvania, March 28.

The patentee says,—"The nature of my invention consists in combining an adjustable metallic throat piece with a plane iron and stock, in such a manner that the discharging aperture for the shavings will not be rendered imperfect or enlarged by the wearing away of the plane stock."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of an adjustable metallic throat piece with the irons and stocks of planes of all descriptions."

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24. For an *Improvement in Hollow Augers;* David George, Granville, Licking county, Ohio, March 28.

The patentee says,—"The nature of my invention consists in arranging and combining with the machine in common use for boring round tenons, an adjustive sliding centreing point, which being forced into the wood at the centre of the part of which it is required to form the tenon, guides the cutters accurately, until a sufficient length of the tenon is formed to enter the tube, after which it guides itself, independent of the centreing point, in the manner of tools in common use for similar purposes. By the use of my invention, the operation of describing a circle upon the end of the piece on which the tenon is required to be cut, and then shaving the wood down to the circle to start the cutters, as is done in using the common hollow auger, is rendered unnecessary, and thus labor is saved, and the work is done with superior accuracy."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the sliding centreing point and plug with the tube and cutter, whether used with the above described slit tube and cutters, or any other apparatus for boring and cutting, as set forth."

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25. For an *Improvement in Cooking Stoves;* James R. Stafford, Cleveland, Cuyahoga county, Ohio, March 28.

The patentee says,—"The nature of my invention consists in the construction of a stove peculiarly adapted to summer use."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the independent oven with the hot air chambers, and the smoke pipe and the top plate of the stove, in such a manner that the stove can be used either with or without the oven, and the temperature of the oven, when used, be perfectly regulated and governed, in the manner set forth."

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26. For an *Improvement in Wrought Nail Machinery;* William M. Gooding, Newark, New Jersey, March 28.

Claim.—"The improvements which I claim, and desire to secure by letters patent, are these: Combining die rollers with the cutters, and these with the holding dies and header, constructed and operating as set forth."

27. For an *Improvement in Water and Fire Proof Composition for Paints, Cements, and other purposes;* William Blake, Sharon, Medina county, Ohio, March 28.

The patentee says,—"I have discovered an earth composed of the following ingredients: about one-half is silica, one quarter, or nearly so, alumina, and smaller proportions of black oxide of iron, sulphuret of iron, lime, and carbon. This earth is pulverized finely by grinding, and mixed with a drying oil to about the consistency of thick paint."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the new paint or cement, made substantially as set forth, by mixing the above named earth with drying oil in suitable portions to produce the results set forth."

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28. For an *Improvement in Washing Machines;* Lewis Tupper, Geneva, Cayuga county, New York, March 28.

The patentee says,—"The nature of my invention consists in making the rollers of the dasher of greater diameter than the rollers of the bed, for the purpose of reducing friction, and preventing the danger of having the clothes injured by passing said rollers back and forth over them, the said rollers being prevented, by reason of their superior diameters, from descending into the spaces between the small rollers of the concave wash bed, and tearing small and fine clothing when in said spaces during the operation of washing."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the rollers of the concave wash board or bed, and vibrating dasher, of different sizes, for the purpose of reducing friction, and preventing the danger of tearing the clothes, by passing said rollers back and forth over them, the said rollers being prevented, by reason of their greater diameters, from descending into the spaces between the small rollers of the concave wash bed, and tearing small and fine clothing when confined in said spaces during the operation of washing—the large and small rollers of the dasher and concave revolving on their axes as the frame swings to and fro over the bed of rollers."

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29. For an *Improvement in Door Locks;* Sylvester M. Pye, Aquackanock, Passaic county, New Jersey, March 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, the improvement of detaching the slide latch of the common door lock from the handle or knob, and securing it so that the door cannot be opened without a key, or the application of force; and the particular construction and combination of the slide latch, No. 1, the detached slide, No. 2, the coupling lever, and the elevating slide, with the common lock case. I disclaim the knob, knob lever, slide latch, key, spring for pressing out the slide latch, and the lock case or shell."

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30. For an *Improvement in the Running Gear of Railroad Cars;* Isaac Knight, Baltimore, Maryland, March 28.

Claim.—"What I claim as my invention, and desire to secure by letters

patent, is the employment of intermediate directing wheels, the treads of which are conical with the larger diameter outside, substantially as set forth, when this is combined with the forward and rear wheels of a truck or car, for the purpose and in the manner set forth."

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31. For an *Improvement in Ship's Windlasses;* Elijah Murray, Peducha, M'Cracken county, Kentucky, March 28.

The patentee says,—"The nature of my invention consists in the method of adjusting the tension of the chains or cords used in drawing up heavy bodies, and equalizing the same, by which an equal motion is produced, without too much on any one point."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing a double chain windlass, substantially as described, the two parts of said windlass being so connected as to equalize the strain in the manner set forth."

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32. For an *Improvement in Painting on Translucent Surfaces;* J. B. Hall, Philadelphia, Pennsylvania, March 28.

The patentee says,—"The nature of my invention consists in preparing plates of glass with a translucent coating, which will receive and retain dry colors, and also admit of the application of colors ground in oil, without spreading, while at the same time serving as a disperser of light; and in placing in the rear of the picture, executed upon the plate of glass thus prepared, a brilliant reflecting surface, which, acting in connexion with the translucent coating upon the glass, will give to the picture a highly luminous appearance."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the improved method of tachygraphic painting, by which I produce brilliant paintings or pictures upon a translucent prepared ground, with a reflecting surface in the rear of the same, as set forth."

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33. For an *Improvement in Cutting Match Splints;* Lewis Smith, City of New York, March 28.

The patentee says,—"The nature of my improvement consists in the combination of certain cranks, levers, cutters, and feeding gearing, for the purpose of cutting, in a more expeditious and economical manner, blocks of wood of suitable sizes into match splints."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, 1st, The combination of the knife and cutting box with the stepping hook, and levers, and cap plate, for the purpose of cutting the match splints as the block or blocks are being fed through the machine.

"2d, The combination of the jointed levers, having a spring at the back of their joints, for the purpose of throwing them out of joint when the cutters have ceased to find any assistance in splitting, and thereby avoiding the cutting of the block or blocks entirely through its crimped or matted surfaces; and their combination with the cutters for working them, and the crank motion for working the crimping or compressing lever.

"3d, The combination of the crimping or compressing lever with the

bed or feed board, for crimping or matting the lower surface of the block or blocks.

"4th, The combination of the shafts and ratchet feed wheels, with the cap plate and bed plate, for the purpose of feeding the blocks through the machine.

5th, The general combination of the several parts I have specified in the foregoing claims, and application of the same to the purposes set forth."

List of American Patents which issued in the month of April, 1848, *with Exemplifications, by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in Hinges for Opening and Closing Outside Blinds;* William Allen, Jr., Meridon, New Haven county, Connecticut, April 4.

The patentee says,—"The nature of my improvement consists in constructing the hinge in such a manner, that the blind will be opened and closed from the inside without opening the window, and fastening it either open or shut in which latter position the blind is secured against being opened from the outside."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the hinge substantially as described, so that the blind can be opened and closed from the inside without opening the window, and by the same operation be fastened at the side opposite the hinge. And I wish to be understood that I do not claim raising the blind or letting it fall to fasten it, nor do I claim opening or closing the blind from the inside, when either of these plans are used independently, but the so arranging the parts as to combine the devices I believe to be new."

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2. For an *Improvement in Rotary Bellows;* Benjamin L. Johnson, Cassawago, Crawford county, Pennsylvania, April 4.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the formation of the passages described, and new mode of constructing the fan wings, combined with the same to secure the advantage as set forth."

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3. For an *Improvement in Jointing Staves;* A. C. Currier, Palmer, and Abel Bradway, Morrison, Hampden county, Massachusetts, April 4.

Claim.—"What we claim as new, and desire to secure by letters patent, is the adapting the jointing cutters to staves of various widths, by securing the cutter wheels in supporting adjustable bearings, united to each other at a common centre, and combining with the same adjustable rests for supporting the edges of the staves, substantially in the manner set forth."

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4. For an *Improvement in a Combined Umbrella and Walking Cane;* S. Wright, Philadelphia, Pennsylvania, April 11.

Claim.—"What I claim as new, and desire to secure by letters patent,

is the manner in which I connect the umbrella and cane, when the latter is used as a handle to the former, which I effect by perforating the ferule, so that the stick may pass through it and into the tube, there being a female screw on the runner, and a corresponding male screw on the ferule, to unite the two firmly together. I also claim the forming of the catch of the spring of an umbrella, so as to hold in the mortise or slot in the runner, with equal firmness at its upper and lower end, by which the umbrella is checked from being inverted by the wind, whilst the runner may be readily slid upwards when it is desired to close the umbrella."

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5. For an *Improvement in a Boot Plane, for trimming the edges of the soles of Boots;* A. V. Hill & R. Arnold, Hamburg, Erie county, New York, April 11.

The patentees say,—"The nature of our invention consists in the combination of a cutting plane with a feather-edge plane, for the purpose of cutting and trimming the feather and edges of boot soles."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the cutting plane with the feather-edge plane, in the manner and for the purposes set forth."

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6. For an *Improvement in the Combination of the Summer Arrangement with the Cooking Stove;* Gilbert Geer, Troy, New York, April 11.

The patentee says,—"The nature of my invention consists in the manner of connecting the summer arrangement with the stove, so that the draught therefrom can be readily turned either into the fire chamber, and thence follow around the oven, or into the exit pipe direct, without imparting heat to any part of the stove, the dampers being so arranged as to revolve and cover either of the openings at pleasure."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the summer arrangement with a stove, having its flues arranged as described, so that the heat therefrom can either be thrown through the fire, entirely around the oven, or be made to pass off through the ascending flue without heating the body of the stove, as set forth."

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7. For an *Improvement in Smut Machines;* Jesse Taylor, Auburn, Cayuga county, New York, April 11.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the rubbers and concave with a notched and smooth portion, in the manner and for the purpose set forth."

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8. For an *Improvement in the Cooking Stove;* Lathrop S. Bacon, Le Roy, Genesee county, New York, April 11.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the central horizontal communication or space, in combination with two fire chambers. And I also claim the construction of the air chan-

nel, the upper part of which consists of a semi-tubular elevation in the casting of the bottom plate of the stove, and the bottom part of the channel consisting of a polished or lustrous metallic plate, in the manner and for the purpose set forth."

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9. For an *Improvement in Sash Fasteners;* G. B. Foster, Taunton, Bristol county, Massachusetts, April 11.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the lever spring with its hook, the second lever with its hook, corresponding with, and to catch into, the hook of the spring, in combination with the sash, so as to press on the munting, as set forth."

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10. For an *Improvement in Lamps;* Jackson Sutton, City of New York, April 11.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the lamp, in combination with the lantern, for said purpose, said lamp being in a socket beneath the socket frame, by which contrivance the slit is made in the socket, and not in the body of the lantern, as in other cases."

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11. For an *Improvement in a Magnetic Electric Machine;* D. A. Morehead, assignee of G. H. & B. H. Horn, City of New York, April 11.

Claim.—"What we claim as new, and desire to secure by letters patent, is the application of the helical expansive spring, conjointly with the stud or pin acting within one part of the U-formed magnet, or in any analogous manner, as set forth."

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12. For an *Improvement in Rat Traps;* N. B. Lucas, Jerseyville, Jersey county, Illinois, April 11.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of hanging the tilt boards, in combination with the arrangement with the catch levers and trigger, acting in the manner set forth."

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13. For an *Improvement in Grain Separators;* Aaron Smith, Birmingham, Oakland county, Michigan, April 11.

The patentee says,—"My improvement consists in the use of a revolving rake for handling the straw, a screen through which the grain passes and is separated from the straw heads and much of the chaff, and a conveyor which receives and carries the grain to the fanning mill."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, 1st, The revolving rake, constructed and operating as described, for shaking up and separating the straw and the grain, and carrying the straw through the machine.

"2d, I claim the motion of the screw, in combination with that of the rake, its motion being pendulous, and in reverse direction to that of the rake."

14. For an *Improvement in Railroad Brakes;* Lucius Stebbins, Hartford, Connecticut, April 18.

The patentee says,—"The nature of my invention consists in arranging the levers that act on the brakes in a line under the cars, or in such position that a cord or chain, which is extended from one end of the train to the other, over pulleys attached to the frame, shall also pass around pulleys in the ends of said levers, in such a way that, when the chain is drawn tight, it shall draw equally on all the levers attached to any given number of brakes, so as to make them act alike on each brake in the train at one and the same time; and said chain being connected with one of the axles of the locomotive, on which it is located by means of a clutch within the reach of the engineer, so that he can at all times command all the brakes of the train."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of a chain or other analogous device, which extends from one end of the car to the other, and by tightening which all the brakes are acted on equally. I also claim, in combination with the above described chain, the reel or drum, and clutch, operated by the engineer, for bringing the brakes into action, as set forth."

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15. For an *Improvement in Plates for Stencilling;* E. B. Foster, Philadelphia, Pennsylvania, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the stencilling plates, the letters of which being formed free and entire from blanks, and adapted to the use of printing banners, awning capes, transparencies, &c., upon canvass, muslin, bunting, &c."

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16. For an *Improvement in Filters;* J. Poree, New Orleans, Louisiana, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, 1st, The combination of a series of chambers, filled with any suitable material for filtering, with intermediate vestibules combined in an exterior case, so that a communication can be established between each vestibule and the induction and eduction pipes, as described, in combination with the pipes and stop-cocks, so that each of the separate chambers can be cleaned, in the manner set forth.

"2d, I claim constructing the partitions between the filtering chambers and the spaces or vestibules, as set forth, by double plates filled with coarse gravel, for the purpose set forth."

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17. For an *Improvement in Blowers for Furnaces;* Manoah Alden, Ralston, Lycoming county, Pennsylvania, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination and arrangement of the circular diaphragm, with the curved tapered wings and hollow frustrums of cones, and rotary shaft, for the purpose set forth."

18. For an *Improvement in Hanging the Bodies of two-wheeled Carriages;* Isaac Woodcock, Worcester, Massachusetts, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the steadying guards with the springs, substantially in the manner set forth."

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19. For an *Improvement in Springs for Closing Doors;* Lucius Evans, Fayetteville, Onondaga county, New York, April 18.

The patentee says,—"The nature of my invention consists in so fixing and adapting an eccentric semicircle, revolving on a pivot a little removed from the centre of the circular movement, as to act upon the door spring, and cause the door to shut in a very regular and even manner."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of the eccentric semicircle to the door spring, said semicircle turning on a pivot, so as to secure a uniform force in shutting the door, as set forth."

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20. For an *Improvement in Kilns for Drying Grain;* E. Knaur & S. Beaver, Jr., Valley Forge, Chester county, Pennsylvania, April 18.

The patentees say,—"The nature of our invention consists in arranging a series of hollow frustrums of cones concentrically one within another, the base of each alternate one being placed at opposite ends, so that they can all be supported on one shaft, and the grain which is to be dried shall enter the centre one, and thence pass from end to end without any spiral conductors, till it is perfectly dry, when it is discharged at the lowest point, and during its progress through the machine it is gradually spread more and more, till it issues from the machine."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is a series of hollow frustrums of cones, having a common axis, and placed relatively as herein described, for drying grain, so that the grain shall enter the centre and pass down through each one of the series, in the manner and for the purpose set forth."

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21. For an *Improvement in Lanterns and Lamps;* J. Stanley Grimes, Lansingburgh, Rensselaer county, New York, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode set forth, of converting a lantern into a lamp, and vice versa; said mode consisting in providing an opening in the top of the lantern, through and above which the flame of the lamp is made to project, by raising the lamp by any desirable means, or lowering the tunie, (which in effect is analogous,) so that the two purposes of a lamp and a lantern are effected by one instrument or fixture, as set forth."

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22. For an *Improvement in Grain Dryers;* James R. Stafford, Cleveland, Cayuhoga county, Ohio, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters

patent, is the expelling the moisture from grain or other substance, by passing it through a box, in which is placed a series of heating pipes and inclined wings, arranged, combined, and operating with each other, substantially as set forth; not intending, by this claim, to limit myself to the exact form and arrangement of the respective parts of the drying apparatus, but to vary them as I may deem expedient."

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23. For an *Improvement in Grain Dryers;* James R. Stafford, Cleveland, Cayuhoga county, Ohio, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the improved apparatus for drying grain or other substances, composed of a box or casing, having a series of heating tubes or surfaces within the casing, combined with a series of perforated tubes or other devices, for carrying off the vapor disengaged by the heat; the whole combined and operating upon the grain or other substance, during its passage through the box or casing, substantially as set forth."

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24. For an *Improvement in Organ Pipes;* David Boardman, Mount Vernon, Hillsborough county, New Hampshire, April 18.

The patentee says,—"My improvement consists in placing a partition of coarse cotton cloth, or other proper substance, punctured with holes, across the chamber, and just above the air induction entrance."

Claim.—"What I claim as my invention, is the employment and use of a partition of cotton cloth (or other proper equivalent) within an organ pipe, in the manner, and for the purpose of improving the tone, as set forth."

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25. For an *Improvement in Window Blind Hinges;* L. T. Talbot, Taunton, Bristol county, Massachusetts, April 18.

The patentee says,—"The nature of my invention consists in so arranging the pintle of the lower hinge that it may revolve, and consequently cause the blind attached to it to swing."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the revolving pintle, whether operated upon by a geared wheel and screw, or in any other manner."

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26. For an *Improvement in Seed Planters;* Lewis Moore, Bart township, Lancaster county, Pennsylvania, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, 1st, The particular combination and arrangement of the levers, round, bar journals with the hopper, frame, and notched supports for moving the hopper and sowing cylinders, in the arc of a circle, for the purpose set forth.

"2d, I claim the combination of the segment slotted box plates, containing the bearings of the cylinder axles, with the hopper, arranged and operated in the manner set forth.

"3d, I claim the manner of attaching the tubular drills to the forked

rods or bars, by means of the wood and iron pins and flanches or wings, as set forth.

"4th, I claim the combination of the chains with the tubes and bar of the hopper frame, by which the tubes are raised or lowered simultaneously with turning the hopper on its axis, as set forth."

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27. For an *Improvement in Machinery for Trimming Books, &c.;* L. F. Markham, Cambridgeport, Middlesex county, Massachusetts, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the turning and adjustable book holder, in its combination with the reciprocating sliding cutter, and as arranged, constructed, and made to operate therewith, or any mechanical substitute therefor, as set forth. And I also claim the adjustable frame, in its combination with the turning book holder, or turning and adjustable book holder, for the purpose, and to operate therewith, substantially as set forth."

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28. For an *Improvement in Grain Dryers;* James R. Stafford, Cleveland, Cayuhoga county, Ohio, April 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of ventilating or heating and drying grain, malt, &c., by passing it through a casing or chamber by its own gravity, amongst a series of inclined planes, arches, semi-cylinders, or other analogous devices, arranged within the chamber, and combined with each other, and with ventilating apertures in the sides of the chamber, substantially as herein set forth; the grain or other substance being exposed to a large extent of surface whilst descending through the chamber, and afforded at all parts of the descending column an opportunity to freely discharge and throw off the moisture disengaged therefrom."

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29. For an *Improvement in Printing Paper Hangings;* R. L. Harris, Worcester, Massachusetts, April 18.

The patentee says,—"The nature of my invention consists in the manner of laying the color on the block, in such a way as to prevent any inequality in its distribution, by allowing them to come in contact while the carriage is moving one way only; and also in the manner of drawing the paper through, by the borders or edges, the proper distance for the pattern that is to be presented. It becomes necessary to convey the paper through by the border, in order to have its length accurate, in consequence of the centre portion, when it receives the color, being dampened thereby, which causes it to stretch unequally, while the border being unprinted, remains the same length throughout the operation of printing; and by only touching the border after printing I avoid marring it."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is combining the carriage with the coloring apparatus, so as to apply the color roller only once over the surface of the block at each impression. I also claim drawing the paper through by the border, by pinching it between the rings and wheels, or by any analogous device, so as to exactly regulate the length drawn through, and not mar the printed portion,

as set forth. I also claim the employment of expanding rings, for the purpose of regulating the length of paper to be drawn through to suit the pattern to be printed."

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30. For an *Improvement in Ploughs;* Frederick C. Smith, Harper's Ferry, Jefferson county, Virginia, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the inclined self-cleaning coulter and point (in one piece) with the share and mould board, in such a manner that the coulter serves not only for the purpose of a coulter, but also as a cutting edge for the mould board, and a supporting brace for giving stiffness and strength to the share and mould board; not confining myself to the essential manner of accomplishing this object as set forth, but to something substantially the same.

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31. For an *Improvement in Ships' Windlasses;* Stephen Holmes, Kingston, Plymouth county, Massachusetts, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is one or more rollers or guide wheels, as combined with, or applied to, a windlass or capstan barrel, and used substantially in the manner set forth."

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32. For an *Improvement in Casting Rolls;* Joshua Graves & W. L. Gordon, Bridgewater, Plymouth county, Massachusetts, April 25.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is in the position of the tube through which the iron passeth to the mould, the improvement in the construction of the gate, and the application of the skimmer, all combined, turning the scoria from the cylinder in which the roll is chilled."

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33. For an *Improvement in Ploughs;* Samuel Hall, Pittsburg, Allegheny county, Pennsylvania, April 25.

The patentee says,—"The nature of my invention consists, first, in combining the beam to the body of the plough, in such a manner that the draught shall be exerted at the centre of resistance, whether the furrow be wide or narrow, deep or shallow; and also enabling the position of the beam to be so adjusted, as to cause the plough to form a deep or a shallow furrow, without varying the base or shoe of the same from a horizontal position; and second, in the peculiar manner of uniting a wrought point and cutter to a wrought share, without injury to the thinner parts thereof, by the process of welding."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, 1st, The manner of securing the beam to the body of the plough, by means of the curved termination of the rear end of the beam, the socket, between the mould board and land side, the ear, projecting from the mould board, with the slot in the same, and the screw bolt; the whole combined and operating as set forth.

"2d, I also claim, in combination with the foregoing method of confining

the beam to the body of the plough, the manner of giving a lateral adjustment to the front end of the beam, by means of the wedge, as set forth.

"3d, I also claim, in combination with the method of securing the beam to the body of the plough, the manner of combining the handle with the beam, by means of the projecting arm, the aperture, and slot in the same, and the screw bolts, combined and operating with the front end of the beam, substantially as set forth.

"4th, I also claim the manner of forming and uniting the wrought share with the point and cutter, by the combination of riveting and welding, substantially in the manner and for the purpose set forth."

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34. For an *Improvement in Horse Powers;* Faulkner J. Norton, Lower Sandusky, Ohio, April 25.

The patentee says,—"The nature of my improvement consists in the connecting the pinions on each end of the main shaft to each other, and to the shaft, in such a manner as to render them perfectly self-adjusting, and enabling them to compensate for any inequality of tension, and imperfection of the endless chain racks by which they are driven, so that the power exerted upon each shall be always equal and uniform."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the pinions with each other, and with the main shaft, by means of the bar, substantially in the manner set forth."

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35. For an *Improvement in Annealing and Cooling Cast Iron Car Wheels;* Asa Whitney, Philadelphia, Pennsylvania, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the process of prolonging the time of cooling in connexion with annealing railroad wheels, in the manner described: that is to say, the taking them from the moulds in which they are cast, before they have become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the moulds, depositing them in a previously heated furnace or chamber, so constructed, of such materials, and subject to such control, that the temperature of all parts of the wheels deposited therein, may be raised to the same point, (say a little below that at which fusion commences,) when they are allowed to cool so fast, and no faster, than is necessary for every part of each wheel to cool and shrink simultaneously together, and no one part before another."

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36. For an *Improvement in Locomotives;* G. A. Nicolls, Reading, Berks county, Pennsylvania, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of an additional set of driving wheels and engines, in combination with the usual driving wheels and engines, under any of the variations known, or of which they are susceptible, as set forth; and secondly, I claim, in this combination, the use of small drivers for the additional set, substantially as set forth."

37. For an *Improvement in Mills for Crushing and Grinding Corn and Cob;* A. P. Norton, Pittsburg, Allegheny county, Pennsylvania, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of cutting the cobs into short pieces, and crushing and grinding the same with the corn, by means of the rotating toothed concave surface, combined with the corresponding toothed concave surface of the auxiliary roller, and these two combined with the conical serrated surfaces, and the serrated rings, substantially in the manner set forth."

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38. For an *Improvement in the Manufacture of Velluted Cloth;* C. H. Brand, Long Island, Kings county, New York, April 25.

The patentee says,—"I take muslin, linen, or any other cloth made of cotton or linen, fasten it with cords on frames; then I take a smooth piece of pumice stone and rub the same off with it. When this is done, I apply to it, with a couple of large round knives or brushes made for this purpose, a composition made as follows:—I take four gallons of linseed oil, in which ¼ lb. of india rubber has been dissolved, (which is done by putting it for about three hours on a strong coal fire,) when I add ¼ lb. of beeswax, and boil it again half an hour; after this, I add ¼ lb. of gum elemi, and boil it a quarter of an hour; then I add 1 lb. of ayrhalt, boil it again for about half an hour, and then, at last, I add 2 lbs. of fine lamp black, mix it well together, and boil this again for about half an hour.—This, when cold, is applied. When I have given the cloth a coat of this mass, I put it into a warm place to dry. I take water and put it on the cloth, and then I take pumice stone and rub it off with the water, dry it again, and give it another coat as before, and treat it in the same manner. When this is done, I apply to it a coat of the following composition, very thin and even: I take 1 lb. of gum copal, melt it in a suitadle vessel, add to it 1 lb. of linseed oil, in which 1 ounce of india rubber has been dissolved; then I take ½ lb. of japan, and 1 lb. of spirits of turpentine, add it, and let it get cold for use. I take ground flock, throw it all over the cloth, and beat it from the underside with a couple of sticks, till the flock has settled."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the composition of the above named articles, by which the ground flock is applied to the cloth."

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39. For an *Improvement in Sand Paper;* Joseph G. Isham, City of New York, April 25.

The patentee says,—"The nature of my invention consists in coating both sides of sheets of paper with sand, glass, emery, or other reducing and polishing substance, cemented thereto, and extending around the sides thereof."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is glueing, or otherwise cementing, sand, glass, emery, or other reducing or polishing surface, on to both sides of sheets of paper, substantially as set forth, whereby the coating on both sides will unite and form well-rounded edges, and thus produce what may be termed a reducing or

polishing tool, presenting the advantages of greater cheapness and durability, and better adaptation to the various kinds of work to be done, and at the same time economizing the time of the operator."

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40. For an *Improvement in Making Hollow Articles of India Rubber;* Chas. Goodyear, New Haven, Connecticut, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the process of making hollow spheres, various hollow toys, or other hollow articles of caoutchouc, the same consisting in the employment of a mould, and heat, and air, substantially as set forth."

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41. For an *Improvement in Tail Blocks of Saw Mills;* Charles D. Wright, East Hadden, Middlesex county, Connecticut, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the elevator, the knee lever, the pawl lever, the pawl, the connecting rod, the balance lever, the vertical connecting rod, the gauge lever, the iron back, and the regulating screw, in combination with the tail block, slide rack, and ratchet, as set forth."

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42. For an *Improvement in Spark Arresters;* P. Connelly, Cincinnati, Hamilton county, Ohio, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the perforated inverted trumpet-shaped spark arrester, with the circle of vertical draught tubes attached to the trumpet-shaped top plate forming the cap, for directing the sparks into the space between the ordinary smoke pipe and outer case, where they are extinguished; the smoke and escape steam passing through the small apertures in the arresters, and through the tubes, and the cinders and extinguished sparks removed through the door at the bottom of the case."

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43. For an *Improvement in Dissolving and Softening Gutta Percha and Caoutchouc;* Chas. F. Durant, Jersey City, Hudson county, New Jersey, April 25.

The patentee says,—"The nature of my invention consists in the employment of perchloride of formyle, otherwise known as chloroform, to dissolve gutta percha and rubber, separate or combined, and in the employment of said solution to make articles of all forms, by running the same into moulds, and by coating or spreading the said solution over moulds, and by dipping moulds into said solution, and in the employment of said solution as a lute or cement to join gutta percha, or gutta percha articles, with other articles, and to join rubber with rubber, and join rubber or rubber articles with other matter or articles; and in the employment of said solution for covering all articles of every kind, by pouring or spreading the solution over the surface intended to be covered, or by dipping the articles into said solution; and in the employment of chloroform to soften gutta percha or gutta percha articles, and to soften rubber and rubber ar-

ticles, so that the softened parts will adhere and unite when pressed together."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of perchloride of formyle, otherwise known as chloroform, to soften and to dissolve gutta percha, and to soften and dissolve rubber."

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44. For an *Improvement in Valves of Steam Engines;* William B. Hill, Grand Rapids, Kent county, Michigan, April 25.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the tubular construction of the double puppet valve, for the purpose of conducting the steam through said tubes to the lower or opposite valve, in its passage to or from the cylinder, substantially as set forth."

Report of the Commissioner of Patents for the year 1848.

UNITED STATES PATENT OFFICE, *January*, 1849.

SIR: In accordance with the provisions of the act of Congress entitled "An act in addition to the act to promote the progress of science and the useful arts," approved March 3, 1837, the undersigned has the honor to submit his annual report:

The whole number of applications for patents, received during the year ending December 31, 1848, is sixteen hundred and twenty-eight. The number of caveats filed during the same period, is six hundred and seven.

The whole number of patents issued during the year 1848 is six hundred and sixty, including twenty-three re-issues, three additional improvements, and forty-six designs; classified and alphabetical lists of which, with the names of the patentees, and their places of residence, are annexed, marked J and K. But one disclaimer was entered during the same.

Within the same year six hundred and twenty-six patents have expired; a list of which is annexed, marked L.

There were during the same period nine applications to extend patents, the terms of which were about to expire; seven of these were rejected, and two granted. Two patents were also extended during the year by act of Congress.

The claims embraced in the respective patents issued during the year 1848 are also annexed, marked M.

As a much larger proportion of the applications are rejected than are granted, and as many of the rejected applications may be reconsidered, and passed, it is not deemed necessary to notice particularly the action of the office with reference to that class of its business.

The receipts of the office during the year 1848, including duties and fees paid into the treasury on applications for patents, caveats, re-issues, disclaimers, additional improvements, extensions, recording assignments and other papers, and for copies, amount, in the whole, to the sum of $67,576·69; of which sum $11,529·33 has been repaid on applications withdrawn, and for money refunded which was paid in by mistake, as per statement marked A.

The expenses of the office, during the year 1847 are as follows, viz: For salaries, $22,584·90; temporary clerks, $7956·80; contingent expenses, $9467·65; compensation of the chief justice of the District of Columbia, sitting on appeals from the Commissioner of Patents, $100; library, $1414·09; agricultural statistics, $2608·17; printing Digest of Patents, $1700; compensation for extra services to E. G. Smith, under the act of Congress for his relief, approved August 5, 1848, $1000;* amounting in the whole to the sum of $46,831·61, as per statement marked B.

There was also expended during the last year, under the act of March 3, 1837, for the restoration of records and drawings, the sum of $44, as per statement marked C.

The aggregate of expenditures under the different heads above enumerated, including money refunded on withdrawals, and money returned, which had been paid in by mistake, is $58,905·84; leaving a balance to be carried to the credit of the Patent fund of $8670·85.

On the first day of January, 1848, the amount of money in the treasury to the credit of the Patent fund was $207,797·98. Thus the amount in the treasury to the credit of the Patent fund, including the balance paid in during the year 1848, was, on the first day of January, 1849, $216,468·83.

The large balances over expenditures which have accrued during the last four years, were caused in part by the great increase of applications for patents, which accumulated to such a degree as to far exceed the ability of the examining force of the office to dispose of them, thus occasioning a disproportion between the applications and withdrawals, as compared with former years. That cause has been removed by the recent increase of the force of the office, and it may now be expected that until the office is relieved of its accumulated business, the proportion of withdrawals to the receipts of the office will be greater than in former years; and consequently the balance which will accrue to the credit of the Patent fund will be less.

By the act of Congress approved May 27, 1848, two principal and two assistant examiners, and two ordinary clerks, were added to the force of the office, and the salaries of the examiners were raised from $1500 a year to $2500, and the assistant examiners from $1250 to $1500. The clerks authorized by the act before mentioned were allowed salaries of $1200 each per annum. Thus the increase of the number of examiners and clerks, and of salaries, provided for by the act of May 27, 1848, will occasion an addition to the annual expenditures of the office of $12,900.—This amount will be reduced by fees for recording assignments, authorized to be charged by the same act; but the permanent addition to the expenses of the office will not be less than $10,000 per annum.

Notwithstanding this addition to the permanent expenditures of the office, the constant increase of its business and receipts gives ample assurance that its revenues will continue to equal, if not exceed its expenses. But if its revenues should, for a year or two, fall below its expenditures, the Patent fund is sufficient to meet such casual deficiencies; and thus the policy of Congress in making the Patent Office a self-sustaining institution will successfully be maintained.

* Allowed Mr. Smith for extra work, out of office hours, on the agricultural report under Mr. Ellsworth.

The two principal and two assistant examiners provided for by the act of May 27, 1848, were appointed as soon as it was believed that suitable persons had been found for those offices, and they entered immediately upon the discharge of their duties. When they had acquired a sufficient knowledge of the duties of their desks, and had become sufficiently acquainted with the routine of business to begin to render efficient aid to the office, which was not before the first of August, the number of applications on hand, awaiting the action of the office, was 998. On the first day of January, 1849, that number was reduced to 539, notwithstanding the difficulties which the examining branch of the force of the office was obliged to encounter, resulting from the inexperience of half their number; thus exhibiting a flattering proof of the progress of business, and promising an early relief from the embarrassments under which the office has long labored, in consequence of the great amount of business which had accumulated during the last three years for want of a force in the scientific desks sufficient to dispose of it. A very few months will probably relieve the office entirely from its present embarrassments.

The rigid examinations now made in the Patent Office with regard to the originality and patentability of new discoveries and improvements, result in the rejection of a much larger proportion of the applications than formerly, when a less scrutinizing system of examination was pursued.—Before I assumed the duties of Commissioner, more than half the applications were patented. During the last four years, not quite half of those which have been examined have been patented, and now the proportion of applications patented to those rejected is about two to three.

Within a few years the inventive genius of this country, under some stimulant or other, not readily perceived, has been more than usually active, and has produced corresponding results. Formerly invention was pursued mainly from an ardent desire to develop the laws of nature, and to adapt them by mechanism and by processes to the uses of man. Now, it is not only pursued from a love of science, and from motives of a noble ambition, but by some as a profession. Hence invention, instead of accomplishing, at the present time, by its essays and experiments, as many striking results, in proportion to the number of its products, as in earlier periods of history, applies itself more to improvement in details. It now aims to improve what already exists in a form more or less imperfect, and to adapt itself to the practical wants of society. In short, it has become more utilitarian than it has been in earlier periods. Such, at least, is the conclusion to which I have arrived from very considerable opportunity to observe the progress of invention in this and other countries during the time I have discharged the duties of Commissioner of Patents.

Yet it would be very unjust to the inventive genius of the present age to affirm that every year does not produce great and original inventions, which illustrate the progress of science, and add much to the elements of civilization and the improvement of society. But my purpose was more particularly to bring to view the fact, that in consequence of the many improvement in details, much is believed to be discovered which was before known; and hence a greater proportion of applications for patents in late years have been rejected than have been patented.

The reports of the four principal examiners, addressed to the undersign-

ed, and giving a review of the most valuable inventions which have passed their desks during the year, are annexed, marked D, E, F, and G.—They are referred to as containing brief but interesting views of the progress of invention and improvement in the mechanic arts in this country during the last year; and also, as proofs of the intricate and difficult duties which that class of officers are required to perform.

In my three former reports I have taken the occasion respectfully to bring to the attention of Congress the propriety and expediency of amending the present statutes relating to patents, with a view to give more efficient remedies to patentees against the infringements and depredations of "*pirates*," as those individuals are appropriately denominated who make it a business wilfully to invade the rights of the inventors, and appropriate the fruits of his ingenuity and labor to their own use. I have in my former reports so minutely pointed out the defects of the present patent system, and so zealously urged their remedy, that it would be but a useless repetition to add more upon this subject than to refer to the views expressed in my reports alluded to.

The experience of every day, and the prolific crop of litigation which has recently sprung up from the unscrupulous and remorseless invasion of the rights of patentees, by persons who have no claim nor pretension to the name of inventor, or the fruits of inventive genius, point with impressive force to the necessity of some reform in the existing law which shall give greater security to the rights vested in patents. The facility of evading punishment, or retribution, for a wilful infringement of the property of patentees, is now so great, that the whole term during which a patent runs is not sufficient, if it be for a very valuable invention, to vindicate and establish the just claims of the inventor. This evil could be remedied by a few simple amendments to the existing law of patents.

If a provision were made for the repeal of a patent, and if it were provided that until it was avoided by process of repeal, the instrument should be received in all actions of infringement as conclusive evidence of the right of the plaintiff to recover, much of the difficulty, expense, and injustice which now fall upon the patentee would be avoided. It is therefore hoped that Congress will speedily act upon this matter, and thus provide for the protection of a class of men who contribute so much to the convenience, comfort, and luxuries of the community, and to the progress of society in science and civilization.

And surely the depredator upon the rights of the patentee—rights which are solemnly and sacredly guarantied to him by law, on the condition that he surrenders to the public the secret of his invention—is not entitled to the sympathy nor the protection of the legislator. The wilful infringer of the rights of the inventor is as base and corrupt, morally, as that class of criminals known as common thieves. His offence is committed from the same depraved and wicked motive. He is impelled by the same corrupt intent, or *animus furandi*, which actuates the perpetrator of a larceny, and should be hunted from society with the same inexorable perseverance.

Justice, therefore, requires that the *wilful* infringer of patents should be punished with the same rigid severity with which the common thief is punished. But the laws enacted by Congress for the protection of the inventor fall very far short of securing to him this measure of justice. Nor is

it asked by him, nor in his behalf. He will be content if the title deed of property which he receives from his government, in consideration of the surrender of his secret to the public, shall be respected, and shall be conclusive as to his right, until it has been duly set aside by the tribunals of his country, in a proceeding against the patent itself.

If his invention were not required to undergo a severe and critical examination, in reference particularly to its novelty and originality, at the Patent Office, there would be some propriety in making his patent merely *prima facie* evidence of title in suits for infringement. But, after it has passed such an ordeal, one trial, at least, in a court of justice, had in good faith, upon the merits of the invention, should be sufficient to establish its validity, and secure to the patentee an undisturbed enjoyment of his property until the end or the term of his exclusive privilege.

It must be obvious, upon the least reflection, that the best and truest interests of society will be aided and advanced by the adoption of a system of policy with regard to inventors, which will give them adequate security and protection in the enjoyment of their rights. If they cannot obtain the security and protection to which their genius and labors entitle them, which justice awards to them, and which are provided for in the constitution and laws of their country, it requires no sagacity to perceive that discovery in science, and improvement in the arts, will be greatly checked; for men will not devote their intellects, their toils, and their fortunes, to pursuits which promise them injustice, spoliation, and poverty, instead of securing for them remuneration, and competency, and honors.

It has come to the knowledge of the undersigned, since his last report, that one method of evading the rights of patentees in the United States, is the setting up of machines in Canada, or other neighboring British provinces, where the articles manufactured by such machines are fabricated, and then brought into the United States and sold, to the great injury of the American patentee. As the sale of the products of a patented machine has been decided by our courts not to be an infringement of the patent, the patentee has no remedy in the case now under consideration.

The protection, therefore, of our own citizens holding patents under this government, would seem to require some legislation for the suppression of these fraudulent practices carried on within the limits of a foreign jurisdiction. A provision, authorizing the seizure and forfeiture of all fabrics and manufactures which have been produced in a foreign jurisdiction, by machines protected by patents in the United States, and brought into this country for sale, would probably be an adequate remedy against such a violation of the rights of the American patentee.

In my last annual report I had the honor to refer the attention of Congress to the expediency of placing the citizens and subjects of foreign governments applying for patents in this country, on the same ground with regard to fees which our own citizens occupy. Deeming the matter of much importance to the interests of this country, I feel it to be my duty again to bring that subject to the consideration of that honorable body.

At present, the subject of a foreign government who applies to this office for a patent is required to pay the sum of $500, if a subject of Great Britain, and $300 if the subject or citizen of any other foreign

power, before his application can be received, while the American citizen is required to pay only $30. It is true that the fees and duties required in most foreign countries are very much higher than those which our laws demand, but they are imposed on all alike, whether subjects or foreigners.

But even if it were just to make a discrimination in favor of American citizens with regard to fees for patents, I am of the opinion that the policy is injurious to the interests of this country, and therefore not expedient. There are in foreign countries many valuable inventions and improvements which are used in secret, for the very reason that the inventors are not able to pay the enormous duties required by their governments for the security of a patent, or are fearful they will not be protected if they were patented. And many of those inventions would find their way to this country, if their proprietors could introduce them without being burdened with a heavy tax at the outset before they could try the experiment of their success.

In my judgment, if the foreigner were placed upon the same equal footing with the citizen with regard to the fees charged upon his application, it would result in a large addition to our stock of useful and valuable inventions and improvements, and better enable our artisans and mechanics to compete with their rivals of other countries. This consideration alone should outweigh the value of the insignificant revenue, amounting each year to but a few thousand dollars, which is now derived from foreign applications.

Nor would it at all interfere with the rights or interests of the American inventor. The competition of invention is not that which arises from the production of the same descriptions of fabrics, but it exists in a proud and honorable rivalry of efforts to produce new things, which do not interfere with each other, but which are accessions to the stock of invention and art already known and in use. The field of invention is as illimitable as the world of mind and matter, and is now but just beginning to be cultivated. There is, therefore, ample room for all explorers after the valuable treasures which yet in rich abundance lie hidden and undeveloped in its bosom, and which will require the thought and labor of ages to discover and reclaim for the uses of mankind.

I am therefore deeply impressed with the belief that the interests of this country would be greatly promoted by encouraging, through the instrumentality of a liberal system of legislation, the inventors and improvers in the arts of other countries to come here with the productions of their genius and labor, and seek a reward by introducing them into use.

In the patent system of most countries, encouragement is offered for the introduction of foreign inventions which have never before been introduced, by granting to such persons as may be at the expense, and sometimes danger, of procuring a knowledge of them abroad, and importing them into their native country—a description of patents called "patents of importation." Those patents secure to the introducer of a foreign invention rights and privileges similar to those which are enjoyed by original inventors.

Our system contains no provision for the granting of patents of importation; yet, in my experience in the office of Commissioner, many instan-

ces have come to my knowledge, where justice and public interest required such a reward to enterprising persons who had obtained a knowledge of valuable inventions abroad, which had not been introduced and were not known in this country.

Recently an enterprising citizen of this country applied to the undersigned to know if there was a legal mode of protecting him for a limited period in the enjoyment of the art of manufacturing Russian sheet-iron, the secret of which he alleged he had obtained. As there was no provision of the existing laws which applied to his case, he was referred to Congress as the only department of the government which could grant him the protection and reward which he claimed.

The secret, which he alleged he had obtained, is a most valuable one, and I believe is known only to the Russian manufacturer of the article. Its introduction into this country would contribute more to our national wealth than hundreds of ordinary inventions made at home; and therefore, in my opinion, the importer was eminently worthy of a reward in the form of a patent securing to him the exclusive enjoyment of it for a limited term of years.

Legislation reaching such cases would certainly be founded in wisdom and good policy. Ample provision could be made against fraud or imposition when patents are applied for to protect imported inventions. The importer of the new art or manufacture should, as the inventor now is, be required to disclose his secret, and a rigid examination should be made into its novelty in this and other countries, as is now made with original inventions, before a patent of importation is granted. By such provisions and guards the new feature proposed may be safely introduced into our patent system.

The undersigned, having had an opportunity during the past year to attend several of the mechanics' fairs which have been held in various cities of the Union, is gratified in being able to bear testimony in favor of the present flourishing condition of the arts in this country. In some branches of the arts and manufactures, the beauty, ingenuity, and skill of workmanship displayed by our artisans cannot be surpassed. They may proudly challenge comparison with the products of the most skilful and and ingenious of other nations. And what is particularly gratifying, is the fact that every year exhibits a sensible progress in the various departments of mechanical industry, and promises at no very distant period to elevate our country to the front rank of nations in the abundance, variety, and perfection of its products in manufactures and other works of art.

(To be Continued.)

Blanchard's Gun Stock Turning Lathe.

Opinion delivered by Judge Kane in the United States Circuit Court in the case of Blanchard *vs.* Eldridge, on a motion for attachment because of a breach of injunction—for an infringement of Blanchard's Gun Stock Turning Lathe as applied to turning Shoemakers' Lasts, March 8th, 1849.

The patent right of Mr. Blanchard has been the subject of examination before me in two trials at law, the present defendant being a party. Although no verdicts were rendered, I was fully satisfied by the evidence,

that the patent was a highly meritorious one, of ancient date, and that the defendant had violated it. I did not hesitate, therefore, to grant an injunction against him, upon the proper proceedings being instituted in equity. This injunction being still in force, the defendant has devised a new machine, and is now using it,—as the complainant asserts, in violation of the injunction. The question is thus presented, whether the new machine of the defendant infringes the complainant's patent right.

In my charge to the jury on the other side of this court, I spoke of Mr. Blanchard's machine as follows:—"It is a turning machine, capable of producing with rapidity from the rough material, by a single operation, an irregular form, similar or proportional in all respects to a given model. It consists essentially of a model, revolving in contact with a friction tracer, while the rough material revolves, with the same velocity, in like contact with a rapidly moving cutter wheel;—either the model and material, or else the friction tracer and cutter wheel, having a progressive lateral motion, so that by the revolutions of the model and material all the points of their respective surfaces are presented in succession to the touch of the friction tracer and the action of the cutter wheel respectively; that is to say, all the points on the surface of the model successively to the touch of the tracer, and the corresponding points on the surface of the material to the action of the cutter wheel. Its value consists in this, that it combines the accurate imitation of a slowly revolving model with the rapid action of a cutter wheel. Its principle is the combination of the cutter wheel, model, and friction tracer, with the arrangement for effecting the lateral motion."

Between this and the respondent's present machine, there appears to be but a single point of difference.

"The peculiar novelty of the respondent's machine, according to the report of the Commisioner, William W. Hubbell Esq., appears to be in the formation, suspension, and manner of propelling the cutting instrument, to shape the last from the rough block, without finishing. The cutting instrument consists of a double edged curved knife of about the same curve or periphery as the friction column; it is bolted to a perpendicular iron bar, about an inch square, which plays up and down between and through two iron straps, fastened to the main transverse carriage. This cutting instrument receives its motion from a pitman, attached to a crank, put in very rapid revolution, and thereby with great velocity moves the cutting instrument in a straight perpendicular line up and down, which being sharp on both the upper and lower edges, in passing the rough material, cuts it both in its ascent and descent. Attached to the crank shaft are a fly wheel and a balance weight."

The two machines then, have the same object; and they attain it by the same means, operating in the same manner, except that Mr. Blanchard's cutters are set on the periphery of a wheel, and act in the curved line of its motion, while in Mr. Eldridge's, the circular motion is transferred to a shaft, and the cutters, being affixed to this, act with an alternating movement in a right line.

It is not contended that the shaft is an improvement on the wheel, that it is more economical of structure or use, or that it does its work more effectively or rapidly. On the contrary, it is evident that, if well

made, it must be more costly at first, that it must exact the expenditure of more power in working, must do the work less rapidly and less perfectly, and must be less durable. The only question to be decided is whether it differs in principle, or by a modification of details merely, a substitution of equivalents,—whether, in a word, it is or is not an evasion of the complainant's patent.

I have heretofore spoken of the principle of the patented machine, as involving the combination of a cutter wheel with certain other parts. This language was sufficiently accurate, perhaps, for the purposes of the occasion, since there was then no controversy regarding a machine without a cutter wheel. But it was rather a description of Mr. Blanchard's machine as in use, than a definition of its principle. The patentee evidently had a broader view of his invention. In his specification he says, "Moreover the cutters may be made sharp on both edges, and the cutter wheel may be made to turn a quarter of a circle or less, backward and forward, and so the cutters be made to cut by both edges; but the continued circular movement is believed to be preferable to any other."

Now, when the cutters are acting with this alternate or reciprocating motion, they can scarcely be considered as moving on a cutter wheel, implying, as this does, the idea of continuous rotation. The abstract principle, therefore, that shall include both forms of structure, cannot recognize the cutter wheel, strictly speaking, as an element of the combination,—but rather a cutter, or series of cutters, deriving motion from a circle, and acting in a circular arc.

If this were the correct definition of Mr. Blanchard's principle, the difference between the two machines would be resolved very easily. One, the patented, applies the revolving power immediately to its work, in the most simple, convenient, economical, and effective mode;—the other, the defendant's, interposes between the revolving power and the work an additional member, that serves no purpose whatever, unless to avoid identity with the patented machine.

The patent law would give but an illusory protection to the meritorious inventor, if it respected devices like this. It requires of a patentee, that he shall disclose in his specification the most beneficial mode of applying his principle that is known to him. (Neilson's patent, *Webster Ca.* 337.) But it does not require of him to go further, and point out all the possible contrivances by which the machine that illustrates his principle can be rendered less beneficial or less perfect. The more fully matured his discovery, the more complete his machine in all its parts, the more signally and immediately profitable to the community,—the greater will be the number of the defects it has avoided or provided for, and the greater of course the number of changes for the worse that may be grafted upon it by a froward ingenuity. For surely ingenuity may be so styled, when it toils with inverted energies, not to improve or advance, but to devise something less useful and more costly than that which was known before.

But, in truth, the principle of Mr. Blanchard's invention calls for a less restricted definition than that which I have for the moment assumed. Strike out from his specification all the details of structure, or look through them into the inventive idea, the essential principle that resides

within, and what do we find? A tracer, so arranged as to pass in a spiral or helix line over the surface of a model,—while the rough material revolves in a similar line under a cutter, guided by the tracer, but acting with independent rapid motion,—the combination of these for a declared purpose: this is the principle of the Blanchard patent. All the rest is detail, properly introduced into the specification, as exhibiting "the most beneficial mode of applying the principle," but essentially forming no part of it.

Now although it be true, that, technically speaking, an inventor cannot claim a patent for the principle he has discovered, yet it is equally true that, if he has embodied it in any clear, definite, and distinct form, others will not be permitted to take that principle and embody it in some other form merely copied from his; "and thus," as was well argued in the case I have cited, "you may attain a result which is practically equivalent to the patenting of a principle;" for when you have put your intention into shape, no person will be allowed to come in and steal the spirit of your invention, by putting it into some other shape, which, though different, is imitated from your's.

The defendant in this case has mistaken his legal rights; and the sooner he is advised of his error, the better for him and for the public. He is obviously possessed of considerable mechanical ingenuity, which, if applied in a different direction, may advance his own interests, while contributing incidentally to the interests of art. But he has confounded the details of Mr. Blanchard's machine with its principle; and in seeking to escape from the operation of the patent, he has violated the law by which it is guarded.

It is possible that he may have been misled by the language of the charge, when his case was before me on the law side of the court. Abstract propositions are liable to inaccuracy, when elicited in the haste of a trial at bar; and however accurate, they are not suited to the purpose of imparting instruction to a jury. I prefer, therefore, generally to employ illustrations, derived from the case itself, to convey the legal principle which should rule it, rather than to announce the law in general and abstract terms. It is enough for me if I can succeed in teaching all that belongs to the circumstances and the time.

This consideration, however, of the possibility of my having been misunderstood, will have its influence with me in the future stages of this proceeding; and the attachment which I feel it my duty to award will be set aside on payment of costs, upon my receiving an assurance from the defendant, that he will desist from violating the complainant's patent any further. *Attachment awarded.*

Mr. Saunders Lewis, for Compl't; Mr. W. L. Hirst, for Respondent.

SPECIFICATIONS OF ENGLISH PATENTS.

We commence this month the publication of Staite's patent for an electric light, and we begin with the specification relative to the light itself, as the battery described in the first part of the patent is, in our opinion, hardly worth publishing, as it is not only no improvement, but in reality, a very inferior form of the galvanic battery. Com. Pub.

Specification of Staite's Patent Electric Light.—[Patent dated July 13, 1847.—Specification enrolled July 13, 1848.]

Fig. 21.

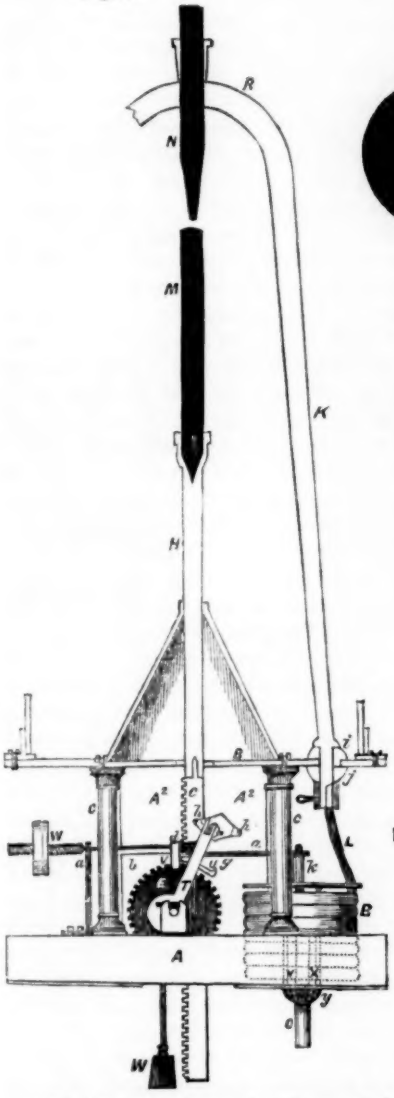
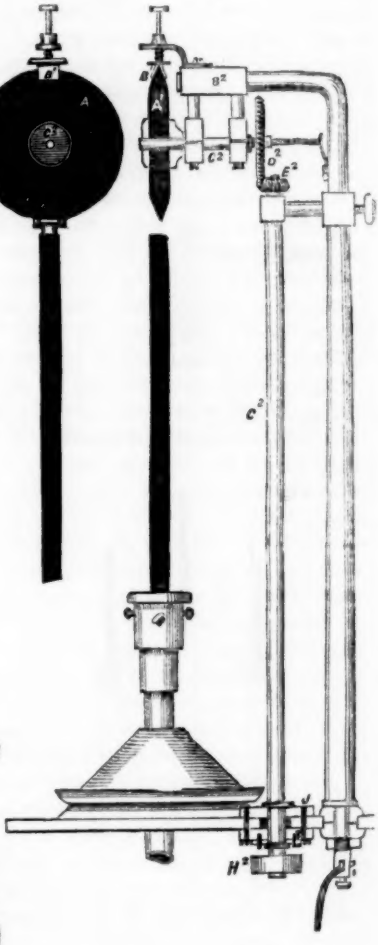


Fig. 23.

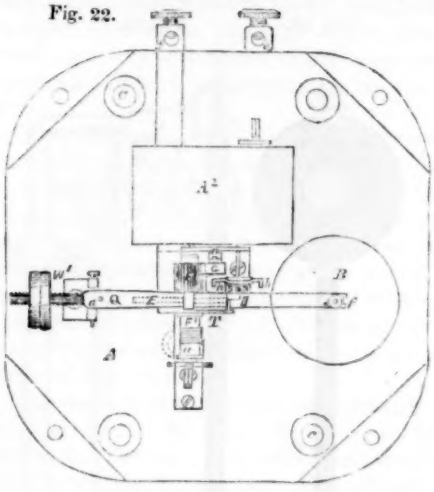
Fig. 24.



"*Tenthly.* My invention has relation to the mode of obtaining light by electricity, for which I obtained former letters patent for England and the Colonies on the 3d day of July, 1847; and consists, first of all, in an improved mode of giving motion to the lower electrode. Figs. 21 and 22

are representations of a lamp embodying this improvement. The skeleton of this lamp is similar in all respects to that of the lamp represented in the specification of my last patent. That is to say, there is, as before, a foun-

Fig. 22.



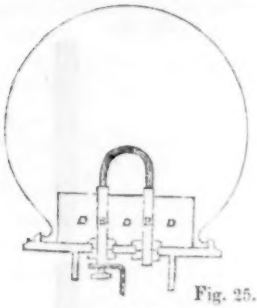


Fig. 25.

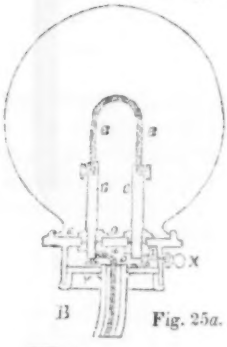


Fig. 25*a*.

Fig. 26.

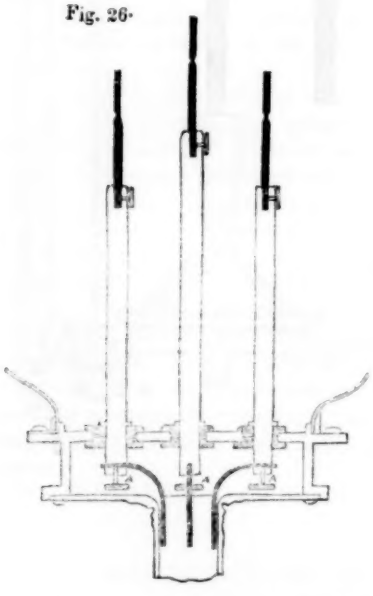
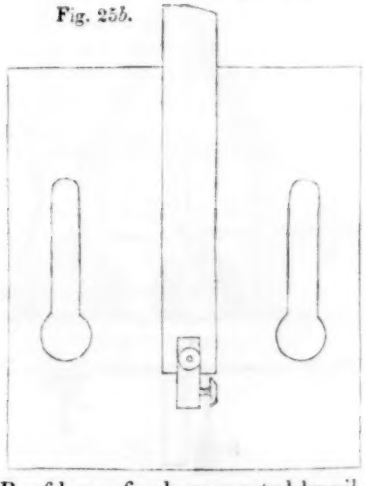


Fig. 25*b*.



dation plate of wood, A, a sole-plate, B, of brass, firmly connected by pillars, C, and a three-legged stand, K, rising vertically from the sole-plate, B, the feet of which are fastened to B by nuts beneath, but insulated by circular washers of dry hard wood (of the form shown in section *i j*). A

hole is bored vertically down through the centre of the top of the stand, K, into which hole the upper electrode, N, is fixed by three metal wedges jambed into key ways or channels, sloping upwards and outwards, so as to keep the inner faces of the wedges parallel to the central axis. A glass shade is fixed to the sole plate, B, so as to cover K. The new parts are as follows: H G is a shaft which slides vertically into the central axis of the lamp, through holes in A and B, and has a socket at top which carries the lower electrode, M. The lower part, G, is cut with teeth which work into a pinion, F, which turns on a spindle in fixed supports. A barrel, F', is attached to the pinion, F, and a weight, W, is suspended by a string which passes round F', and is fixed to it, so as to counterpoise the weight of H G. On the spindle of the pinion, F, is fixed a wheel, E, having square teeth. A lever, T, turns loosely on the same spindle as a fulcrum, and carries a double pawl, U V, which turns on a pin which projects from the side of T, so that this pawl, U V, can lock into the teeth of the wheel, E, in either direction. A long horizontal lever, Q, passes over this pawl from a joint or fulcrum, *a*, and this lever carries a light spring, or tongue, *l*, close beneath it, the end of which is kept from springing away from the lever, by resting in a step in a little stirrup or fork, *d*, which is attached to the lever, Q, and embraces the wheel, E, and the end, V, of the pawl. The pawl and its lever, T, are kept in a state of slow vibration from side to side by means of a crank, S, which works in a fork at the end of T, the crank, S, being made to revolve by an ordinary train of wheel work, furnished with an escapement or fly-wheel, A^2, and driven by spring power or weights. When the lever, Q, is turned a little downwards, its tongue, *l*, presses V into the teeth of the wheel, E, and the vibratory motion of T causes V to drive the wheel round, notch by notch. The wheel does not follow the pawl in its back motion at every stroke, for this is better ensured by having a spring, *n*, (fig. 22) fixed to A, and pressing against the side of G. This motion of the wheel causes the pinion to elevate the rack, G, slowly, so as to raise its electrode, M, towards N. But when the lever, Q, is raised or turned upwards, the notch in the stirrup lifts the tongue, *l*, off V, and allows U, the heaviest end of the pawl, to drop into the teeth of the wheel, E. This drives it round in a contrary direction, so as to lower the rack, G, and draw its electrode, M, further from N. Whenever the lever, Q, is raised, the lower step in the stirrup, *d*, catches the sides of V, and draws it (V) up out of the teeth of the wheel, in case V should have become jambed, or hitched, in the teeth, so that the counter weight of U might be unable to release it. The means by which the end of the lever, Q, is raised or lowered, are these: R is a regulator coil, such as is described in the specification of my last patent; one end of its wire is connected with the binding screw, *e*, and the other end, L, is brought up and fixed in contact with K. An iron rod, O, moves freely up and down in the central hole of the coil, and is prolonged upwards by a stem of wood, *p*, by which it hangs to the end of the lever, Q, in the manner shown in figs. 21 and 22. The rod, O, passes through a hole in the centre of a cup, *y*, which screws into the bottom of the coil case. Around O there is a circular weight, X, called an equilibrium weight, which rests on a small step in O, when O is raised. When O sinks below its medium position, it is left

behind, resting on the edge, or rim of *y*. The object of this arrangement is, that when O is actuated by a force equal to its own weight, added to half the weight of X, then it will have a tendency to return to its medium position, with a force of half the weight of X, whether it be raised higher, or sunk lower, than that position. The mode of action is as follows:—The end of the negative wire from the battery is set in the binding screw, *f*, and is conducted thence by a metal connexion, to the supports of the spindle of the pinion, and to the spring, *n*. The current passes through these into the rack; thence to the lower electrode, M, from which it passes to the upper one, N, producing the light between them. From N it proceeds through the stand, K, to the wire, L, of the regulator; thence to the clamp, *e*, which is in connexion with the other end of the regulator wire, and into which the positive wire from the battery is clamped to complete the electric circuit. The current, in passing through the regulator, tends to raise the iron centre, O, which being connected to the lever, Q, is counterpoised by the weight, W^1, which screws along an extension of the lever beyond the fulcrum, *a*. To put the lamp into adjustment, the driving gear being wound up, and the battery being in a state of activity fit for the permanent action intended to produce the light, and its wires connected with *e* and *f*, as described, the lever, Q, is raised by hand until the electrodes have separated to the greatest extent compatible with obtaining a permanent light from them. The screwed weight, W^1, is turned backwards or forwards until it keeps O balanced, just so as not to sink below its medium position, when the electrodes are separated as aforesaid. When in this position, the shoulder of O touches the weight, X, which is resting on the rim of *y*. The lever, Q, carries a little projecting piece or catch, *g*, which meets the bent arms attached to the crank-spindle, S, and thus arrests the motion of the crank, when the lever lies so that O is in its medium position; but whenever it rises above or sinks below that point, the catch, *g*, allows *h h* to pass beneath or over it accordingly, so that the crank can revolve freely and work the ratchet, U V.

Another improvement in the lamp consists in substituting for the upper electrode, previously employed, a disk or circular electrode fixed on an axis, which disk has a slow motion imparted to it, in any given direction, by the moving power employed in the lamp. Impinging on the periphery of this disk, there is a metal scraper, which keeps the edge of the disk clean, and free from the particles of carbon which are projected upon it by the other electrode, and which ordinarily collects in the shape of a button on the point of the electrode. A front view of a lamp on this plan is given in fig. 23, and a side or edge view in fig. 24. A^1 is the disk, which, as shown in section, fig. 24, resembles in its form two cones, placed base to base, so that there is always one sharp or feather edge in sight (so to speak) of the negative electrode, which is of the ordinary single-cone form. B^1 is the scraper; B^2 is a frame which carries the shaft, C^2, to which the disk electrode, A^1, is attached. D^2 and E^2 are a beveled wheel and pinion, which gear into one another, the latter being fixed to the shaft, G^2. At the bottom of this shaft there is another wheel, H^2, to which the clockwork, or other apparatus for giving motion, is attached. The shaft, G^2, may be insulated in various ways, either by the interposition of plates of

ivory or wood, J K, screwed together, or by gutta percha or india rubber rings. Instead of the shaft, G^2, and the wheel and pinion, D^2 and E^2, a metallic chain may be used, working over a pulley or pulleys, the object being to give a slow motion only (say one revolution an hour) to the circular disk of carbon, and for the purpose solely of keeping the edge of the disk sharp and free from the projected particles, as described.

Another improvement consists in the employment of iridium, as an electrode, which is especially suitable for smaller lights. Iridium being, of all known metals, the hardest and most intractable, will bear an excessive degree of heat without fusing. To adapt it for electrodes, I prepare it as follows:—I fuse oxide of the metal in a cupel of bone-ash, under the voltaic arc, by which means it is brought under the action of the most intense heat with which we are acquainted. Having obtained an ingot of the metal, I submit the same to the constant action of heat for the purpose of annealing it; and for this purpose I use one or more large jets from an oxy-hydrogen blow pipe. When the ingot is at a white heat, I pass it between rollers, or hammer it, repeating the process again and again, until the metal is sufficiently annealed to be worked up into the required shape. Sometimes I mix platinum with the iridium, and sometimes copper, in small quantities, which facilitates the annealing. Sometimes, also, I cut it into thin strips from the ingot, in the same way as precious stones are cut by the lapidary. For lighting purposes, I use either a thin strip of the iridium, so prepared and cut off, or a combination of iridium with platinum, or of iridium with copper, or a spiral coil of the iridium instead of a solid electrode. Platinum strips and platinum wire have been used before, and are well known; but iridium so prepared has never, to the best of my knowledge, been before used for the purposes of lighting.

To increase the temperature of the metallic electrode, A^1, I sometimes pass the metallic holders, B B, through a block of glass, D D D, or some other similar bad conductor of heat, as represented in fig. 25, so that the heat and radiant light may be developed with as little loss of the former as possible by radiation.

An elevation of a small iridium bracket lamp, is given in fig. 25^a and 25^b. A^1 is the electrode of iridium, which is fused on, or otherwise fixed to, two pieces of platinum, B B, which are fixed into two copper or other metallic holders, C C. These holders are insulated by means of ivory, wood, or vulcanized india rubber washers, D D, or some other suitable non-conducting substances, so as to prevent contact with the bottom metal plate of the lamp, E. To one of the metallic holders a copper wire, a^1, passing through the hollow tube, B^1, is connected with one pole of the battery, and the electric circuit is completed, and the current made to pass through the brass-work of the lamp to the electrode, by turning the ivory knob, X, which is attached to a screw-shank, Z, making a metallic communication with the other holder. The second wire from the battery may be attached to any part of the lamp or socket, as, for instance, by a binding screw. W Y is a ring of brass, which is screwed into the bottom of the lamp. A glass shade, of any shape or form, may be placed on the plate E.

Fig. 26 represents a triple electrode suspending lamp. Each electrode is independent of the others, and insulated as before. A battery for work-

ing this lamp is divided into three parts, one for each electrode. One wire for the return current (which may be fixed to the lamp, or any part of the metallic tube by which it is suspended) is sufficient for all three electrodes; but each electrode is rendered luminous by completing the circuit of that particular electrode, as before described. A A A, fig. 26, are three ivory knobs, with metallic shanks, for making the necessary communication, as before described. Lond. Mec. Mag., Jan. 1849.

MECHANICS, PHYSICS, AND CHEMISTRY.

Report on the Gases evolved from Iron Furnaces, with reference to the Theory of the Smelting of Iron. By Prof. BUNSEN, *of Marburg, Hesse Cassel, and* Dr. LYON PLAYFAIR, *of the Museum of Economic Geology, Department of Her Majesty's Woods and Forests.*

From the Report of the British Association for the Advancement of Science, for 1845.

In laying before the Association the report which we have now the honor to present, we are desirous, at the commencement of our subject, to examine closely the methods employed in the analyses of gases, not only as an argument in favor of the processes used by ourselves, but also with the hope of improving the present state of eudiometry.

Two distinct methods are employed in the analysis of combustible gases; one of which consists in an exact determination of the VOLUMES of the gas about to be examined, and of those resulting from the combustion of its constituents with oxygen. By the other method, the products of combustion are collected in the liquid and solid form, and estimated directly according to WEIGHT.

The last method would doubtless deserve the preference if we had to operate upon a mixture of gases capable of being determined by the products of combustion without reference to the quantity of oxygen necessary to effect it; in other words, when we have to examine a mixture containing only two combustible gases. In such a case, the combustion by means of oxide of copper affords products well adapted for exact determination by weight. But, on the contrary, when the quantity of oxygen necessary for the combustion must be introduced as an element into the calculation, as is the case with the gases examined by us in the present paper, the method of analysis by weight is not only inexpedient, but also inexact. If that method were to be adopted, it is necessary to determine the loss (often not amounting to above a few centigrammes) sustained by a heavy combustion-tube, by weighing it before and after the experiment, and thus subjecting it to all the sources of error due to a varying hygroscopic condition, and to the loss in weight occasioned by the long exposure of a considerable body of glass to a red heat. Another source of error equally great consists in the necessity for filling the whole apparatus for combustion and condensation with nitrogen gas previous to the commencement of the experiment. The smallest quantity of oxygen which may remain in the gas, or in the porous oxide of copper, or which may be introduced by diffusion, must derange the results, and cause great uncertainty in the determinations. An error arising from this source is so

much the more to be feared, because it does not affect one constituent merely, but extends its influence equally to the ascertained value of all the other ingredients.

We cannot afford better arguments for the reception of our methods of investigation than by briefly reviewing the results obtained by different inquirers in the examination of the gases evolved from furnaces worked by charcoal. It is obvious that the composition of these gases cannot be the same under all circumstances, for the nature of the fuel, the pressure of the blast, and even the shape of the furnace itself, must exert a varying influence in modifying the processes which affect the composition of the gases. But when we consider, at the same time, that these modifying influences have their maximum and minimum in corresponding parts of furnaces treated in a similar manner, we still have a right to expect an elucidation of the law regulating the formation of the gases by a careful comparison of their composition. One of us first endeavored to solve this problem by an examination of the gases issuing from the furnace of Vickerhagen, although he did not then consider the results obtained in the inquiry as expressive of a general theory of the nature of the processes in the furnace. This research was afterwards pursued in a similar manner, and with confirmatory results, by Scheerer and Langberg in the iron works of Baerum. Both these chemists have conferred a lasting benefit on this new field of metallurgical inquiry by their elaborate investigations; and as their experiments agree with those performed in Germany, the generality of the law regulating the production and action of the solid and gaseous products of charcoal furnaces is established. This is shown by a comparison of the results obtained at Vickerhagen and Baerum:—

Height above the tuyère	Composition* according to volume of the gases at Vickerhagen.						
	17¾ feet.	16½	14¾	13½	11¾	8¾†	5¾
Nitrogen	62·34	62·25	66·29	62·47	63·89	61·45	64·58
Carbonic acid	8·77	11·14	3·32	3·44	3·60	7·57	5·97
Carbonic oxide	24·20	22·24	25·77	30·08	29·27	26·99	26·51
Light carburetted hydrogen	3·36	3·10	4·04	2·24	1·07	3·84	1·88
Hydrogen	1·33	1·33	0·58	1·77	2·17	0·15	1·06
	100·00	100·00	100·00	100·00	100·00	100·00	100·00

Height above the tuyère.	Composition according to volume of the gases at Baerum.					
	23 feet.	20½	18	15½	13	10
Nitrogen	64·43	62·65	63·20	64·28	66·12	64·97
Carbonic acid	22·20	18·21	12·45	4·27	8·50	5·69
Carbonic oxide	8·04	15·33	18·57	29·17	20·28	26·38
Light carburetted hydrogen	3·87	1·28	1·27	1·23	1·18	0·00
Hydrogen	1·46	2·53	4·51	1·05	3·92	2·96
	100·00	100·00	100·00	100·00	100·00	100·00

* We have found it necessary to correct the calculations given in the original memoir in Poggendorff's 'Annalen,' as they are, almost without exception, erroneously calculated.

† The gas taken from a depth of 8¾ feet is anomalous in composition, but as this is obviously due to one of those disturbances which frequently take place in furnaces of small dimensions, we neglect the consideration of this analysis.

A simple inspection of the comparison now instituted is sufficient to show that the law, regulating the changes suffered by the ascending column of gas in furnaces supplied with charcoal as fuel, is the same in those of Vickerhagen and Baerum. In both cases the carbonic acid diminishes as we descend from the upper part of the furnace towards the hearth, until it attains a minimum, when it again begins to increase, without however reaching the proportion which it at first possessed. In both cases the carbonic oxide attains its maximum about the middle of the furnace, and diminishes in a greater ratio upwards than downwards. In both furnaces the quantity of carburetted hydrogen remains constant in the upper part, and diminishes, although still relatively constant, in the lower region: and finally, in both cases, an irregularity in the quantity of hydrogen, probably caused by local influences, is observed at all depths. It could scarcely be expected that these phænomena should proceed at proportional heights of furnaces of different sizes; but it would not be difficult to explain the influence exerted upon the maximum and minimum composition of the gases at different positions by the dimensions of the furnace, the nature of the materials, and the pressure of the blast, as soon as proper data are furnished by continued inquiries in this field of research.

The great accordance between the results of the two series of experiments now detailed, executed as they were quite independently of each other, the one series in Germany, the other in Norway, renders it surprising that a similar inquiry instituted by Ebelmen on the furnaces of Clerval and Audincourt should have led to results differing so essentially from those now described. This chemist gives the following composition, according to volume, for the gases of the furnace at Clerval:—

Height above the tuyère	25½ feet.	22½	17½	13½	9½	8
Nitrogen	57·79	57·80	58·15	59·14	60·54	63·07
Carbonic acid	12·88	13·96	13·76	8·86	2·23	0·00
Carbonic oxide	23·51	22·24	22·65	28·18	33·64	35·01
Light carburetted hydrogen	0·00	0·00	0·00	0·00	0·00	0·00
Hydrogen.	5·82	6·00	5·44	3·82	3·59	1·92
	100·00	100·00	100·00	100·00	100·00	100·00

The difference of these results from those detailed above is very striking, especially when we consider that carburetted hydrogen is entirely absent from Ebelmen's analyses, and that the hydrogen is as great as 6 per cent. The close relation between the nitrogen and oxygen of these gases, and especially the great regularity in the increase and diminution of their respective constituents, would certainly appear to be a guarantee for the accuracy of the analyses. Indeed Ebelmen himself seems so deeply impressed with their value and with their exclusive accuracy, that he has considered it quite unnecessary even to refer to the previous elaborate investigations on this subject in Germany. As he has not honored one of us, the author of these investigations, with a reference, of course the difference between his results and those of that paper still remain unexplained, and we shall therefore endeavor to fill up this gap in our knowledge.

The analyses of Ebelmen differ from our own in being quite destitute of carburetted hydrogen. It would be a great error to suppose that the

absence of this ingredient is not essential. The gas escaping from the furnace at Baerum contains, according to *weight*,—

Nitrogen	58·95
Carbonic acid	31·68
Carbonic oxide	7·28
Carburetted hydrogen	2·00
Hydrogen	0·09
	100·00

The two parts of carburetted hydrogen contained in this mixture give, on combustion, 26938 *units** of heat; and no less than 10·76 parts of carbonic oxide would be necessary to generate the same amount. An error of 2 in the quantity of carburetted hydrogen, with respect to the combustible value of the gas, is equivalent to a loss of 10·76 parts of carbonic oxide gas. But surely a theoretical conclusion must be of small value when based upon an analysis in which there are errors of more than 10 per cent. of the carbonic oxide. It therefore becomes a most important question to determine whether carburetted hydrogen ought to be considered as an essential constituent of the gases, and whether its absence in the cases cited is due to an error in Ebelmen's analyses.

It is well known that ordinary charcoal is very far from being pure carbon, and that it in fact contains about 20 per cent. of foreign matters, which escape as gaseous and liquid products when it is heated to redness. If carburetted hydrogen forms, as it is generally supposed, an essential constituent of the gases resulting from the distillation of wood-charcoal, it is quite clear that it cannot be absent from the gases of furnaces supplied with that fuel. Although the presence of carburetted hydrogen in the gases obtained by the distillation of charcoal is generally acknowledged, we have thought it not superfluous to put this fact beyond all doubt by a renewed examination. The charcoal subjected to experiment was heated in a narrow glass tube, connected with a long dry tube to retain the liquid products of distillation, and the gases, after passing through this, were collected over mercury. In order to remove any elayl or hydrated oxide of methyl, which might possibly have accompanied the gases, they were conducted through a long tube filled with fuming sulphuric acid, attached to which was another tube moistened with water. The analysis of the gases was then effected in an exact eudiometer, and according to the methods which we describe in an after part of this report.

I. A specimen of very well-burnt charcoal, from beech-wood, yielded a gas of the following composition, according to volume:—

Carbonic acid	23·65
Carburetted hydrogen	11·00
Carbonic oxide	15·96
Hydrogen	49·39
	100·00

II. A good specimen of charcoal from fir-wood, also well burnt, gave a gas constituted as under.

* *Unit* of heat is a convenient term to employ in the present report, because it expresses a standard amount. The amount of heat necessary to elevate 2·204 lbs. of water (1 kilogramme) from 0° Cent. to 1° C., we assume as unity.

III. 0·6500 gramme of oak charcoal, of a similar nature to the last, left behind 0·47 carbon, and yielded 70 cubic centimetres of gas at 0° C., and 0·76 bar., consisting as under.

IV. 0·733 imperfectly burnt beeeh-wood charcoal, pulverulent, and of a blackish-brown color, left 0·443 carbon and 250 cubic centimetres of gas at 0° C. and 0·76 bar., which gas was composed as under.

	II. Gas of Fir charcoal.	III. Gas of Oak charcoal.	IV. Gas of Beech charcoal.
Carbonic acid - -	15·96	19·58	35·36
Carburetted hydrogen -	20·32	20·75	20·78
Carbonic oxide - -	13·62	20·57	14·41
Hydrogen - - -	50·10	39·10	29·45
	100·00	100·00	100·00

If we assume the most unfavorable condition to the calculation, that the charcoal used in the furnace of Clerval was of the most select quality, which could not have been the case, it follows from the analysis and consumption of charcoal at that place, that no less than 479 cubic feet of light carburetted hydrogen must have escaped from the top of the furnace every hour, and yet not a trace of this large quantity is to be found in Ebelmen's analyses. The above experiments prove beyond contradiction that the carburetted hydrogen found by Scheerer and by us in the gases from charcoal, is actually an essential constituent of furnace gases. The absence of this important ingredient from Ebelmen's analyses might be explained on the supposition that the gases upon which he operated were collected from a part without the column of charcoal, and between it and the lining of the furnace. However, we cannot reproach Ebelmen with drawing a theory of the mutual action of the gaseous and solid products of the furnace from a mixture of gas which had only partially been subjected to this action, because the presence of 7 per cent. of hydrogen indicated by his analyses would be still more inexplicable on this supposition. Hence we must look to another source for the errors in his analyses, and it will be found to lie in the incompleteness of the methods used by him. His method of determining the nature and composition of the combustible gases, was to pass them over red hot oxide of copper, collecting the products of combustion in the usual way, and forming an opinion of the presence or absence of carburetted hydrogen by the loss in weight of the combustion tube. In order to show the degree of inaccuracy of this method, it will be best to choose a special case as an example, and as such we select the first analysis of the gases of Clerval. The volume of gas used in his experiments, 1500 cubic centimetres,* contained 87·3 cubic centimetres of hydrogen, and 352·65 cubic centimetres of carbonic oxide gas. In order to burn this quantity, the combustion tube suffered a loss in weight of 0·3160 gramme. If we supposed the whole of the hydrogen to be present as carburetted hydrogen,

* In the details of our analyses we always employ the French weights and measures, now universally used on the continent, and by most of our eminent chemists in this country.—Their convenience is very great, and as science is universal and not local, English memoirs are more readily adopted on the continent when the translators have not the trouble of reducing our weights and measures. Where the numbers are absolute and not relative, we employ English measures.

taking its carbon from a corresponding quantity of carbonic oxide, the 1500 cubic centimetres of gas must have contained 43·65 carburetted hydrogen and 309·0 carbonic oxide; and, on this supposition, the combustion tube must have diminished in weight 0·3473 gramme, instead of 0·3150 gramme. It will be seen from this calculation, that the question as to whether the mixture of gases contains 5·82 per cent. hydrogen, or *instead of that quantity*, 3·09 light carburetted hydrogen, is entirely dependent upon a difference in weight of not more than 0·0323 gramme. Let us assume that the weight of the combustion tube and its contents was 80 grammes, then an error of $\frac{4}{10000}$ in the weighing would cause a change in the results from the composition, as found by Ebelmen, to that placed beside it calculated on this supposition:—

	According to Ebelmen.	On the supposition that he was liable to an error of only $\frac{4}{10000}$ in weighing.
Nitrogen - -	57·79	61·36
Carbonic acid - -	12·88	13·68
Carbonic oxide - -	23·55	21·87
Carburetted hydrogen -	0·00	3·09
Hydrogen - -	5·82	0·00
	100·00	100·00

Such uncertainties as these are never to be feared in a eudiometric analysis conducted with proper precautions; for they would imply errors in measurement which could not take place without the most gross negligence. Now when we consider the circumstances which would tend to diminish the loss in weight of the combustion tube in Ebelmen's experiments, and consequently diminish the quantity of carburetted hydrogen, while it increased that of hydrogen, we shall be the more inclined to attribute the erroneous results of his experiments to the uncertain methods employed by him in analysis. The smallest quantity of oxygen remaining in the nitrogen with which the apparatus was filled previous to the experiment, the gases retained by the porous copper formed during the reduction, the carbon also retained by this copper, the smallest quantity of foreign substances which may attach themselves to the combustion tube, softened as it is by heat during the experiment,—all these must tend to increase the chances of an error of $\frac{4}{10000}$ in weighing; a difference so small as even without the operation of these causes almost to be within the errors of observation, and sufficient to account for the erroneous results obtained by Ebelmen. But whatever may have been the grounds which induced Ebelmen to avoid referring to the original investigations in Germany, when we consider the great labor which he bestowed on the inquiry, it will ever remain to be regretted that he did not introduce into his memoir on explanation of the grounds upon which he accorded the preference to his method of analysis, which differs from that of his predecessors in the inquiry more by its tediousness than its accuracy, and which we consider it necessary altogether to avoid in the following research. At the same time it cannot be denied, that eudiometric analysis, as usually performed, is little deserving of high commendation, or of universal adoption, although this is less owing to its incompleteness than to the neglect

of the many precautions which should be adopted to procure accuracy. Before proceeding to our investigation, we thought it necessary to examine with great care all the conditions essential to obtain a proper degree of accuracy. It cannot, therefore, be thought superfluous to describe in detail the methods employed in the inquiry, especially as these must form the foundation for the reception of the conclusions which we draw from the experiments.

The combustion and measurement of the gases is most conveniently and accurately performed in uniform glass tubes of 18–19 inches in length and about 0·6 inch internal and 0·8 inch external diameter; in the closed end of the tube there is inserted by fusion two platina wires of the thickness of horse hair, for the purpose of passing the electric spark. The tube is divided into millimetres, and with this view, is covered with common etching paste, or still better, with a thin layer of wax containing a little turpentine, which may be laid very uniformly on the warmed surface of the glass by means of a hair pencil. The glass is then minutely graduated by a peculiar instrument, and subjected to the action of gaseous hydrofluoric acid, which, when evolved from a paste of fluoride of calcium and concentrated sulphuric acid placed in a vessel of lead slightly warmed, effects the etching in ten to fifteen minutes, and much more legibly than the liquid hydrofluoric acid usually employed in the graduation of thermometers.

The capacity of the tube, which has thus been divided into millimetres, is easily determined by measurement. For this purpose, the tube is placed vertically on the table, its hermetically sealed end being downwards, and is then filled with successive portions of mercury carefully measured. The different lengths occupied by these equal volumes correspond to equal capacities of the tube. If the mercury in the successive parts of the tube *ab*, *bc*, *cd*, *de*, &c. take up the lengths measured on the graduation L L′ L″ L‴, and the short parts of the tube *ab*, *bc*, *cd*, &c. be considered uniform in calibre, we obtain respective values of the divisional marks between *ab*, *bc*, &c. with respect to the volumes corresponding to them expressed by the unity corresponding to the length L, when L′, L″, L‴ &c. are divided by L. On adding together these quantities, a graduation originally arbitrary becomes a comparable measure corresponding to the capacity of the tube. We obtain by this means a table of correction which gives the true volume of the tube corresponding to each mark.

It is necessary, in order to obviate the parallax on reading from the surface of the mercury, to use a small movable mirror (figure 1) which is placed on the opposite side of the tube. If the pupil of the eye seen through the tube in the mirror appears halved by the mark corresponding to the convexity of the mercury, the reading may be considered as exact. If the volume of the measured gas be read, as must always be the case, from the highest point of the convexity of the mercury, we must add to the corrections a small constant quantity deduced from the value found in the plate, and which may be named the fault of the convexity, the necessity for which will be rendered obvious by the following consideration:—If the reading of the volume of the mercury during the measurement of the instrument be at the mark *a*, the capacity *a a b* is not measured, but only the volume *c g e b* (fig. II.)

Now on using the instrument, if we read a volume of gas at the same

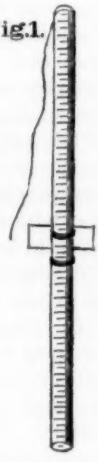
mark a, the convexity takes the place $d\,g\,\delta$, this volume as read does not correspond to $c\,g\,e\,b$, but to the real capacity $c\,g\,e\,b + d\,c\,g\,e\,\delta$. Hence the quantity $d\,c\,g\,e\,\delta$ is not measured by the reading, and must therefore be added to the volumes observed, which otherwise would be too small. This quantity may be ascertained by an experiment, and serves for all future corrections. If a dilute solution of bichloride of mercury be placed in contact with the convexity, it disappears immediately, on account of the formation of a thin layer of protochloride of mercury which adheres to the glass. The mercury now shows the horizontal surface $f\,\beta$. The quantity $g\,c\,a\,a\,e$ is obviously equal to $a\,a\,\beta\,f$, which may be measured directly by the divisions on the tube. Hence the quantity $c\,g\,d\,\delta\,g\,e$ must be equal to $2 \times a\,a\,\beta\,f$, which is the quantity that must be added to the observed volume on every reading.

Another source of error may arise from air bubbles, which are apt to attach themselves to the glass during the filling of the tube, and being loosened when gas is admitted, render the latter impure. If these bubbles of air be visible to the naked eye, it is easy enough to separate them by means of a wire; but the walls still remain covered with microscopic bubbles which cannot be removed in this way. In order, therefore, to prevent altogether this danger to the experiment, it is necessary to clean very carefully with unsized paper the walls of the tube after every experiment, and to introduce the mercury by means of a funnel with a long neck ending in a narrow opening at the lower end, and placed at the bottom of the tube. The mercury flowing from this funnel adheres to the walls of the tube, with a perfectly clear mirror-like surface.

Fig.11.

Fig. 111.

Fig.1.



Especial care must be taken that air neither enters nor escapes during the combustion of the gas in the eudiometer. This evil is perfectly avoided by pressing the open end of the instrument, during the explosion, upon a perfectly smooth sheet of caoutchouc placed under the mercury in the pneumatic trough. However, it is quite necessary to take care that the caoutchouc has not carried down with it any air, which might easily find its way into the eudiometer by the diminished tension of the gas. The caoutchouc is therefore moistened with a solution of corrosive sublimate, and very slowly sunk into the mercury; the protochloride of mercury formed between the mercury and the caoutchouc causes such complete adhesion as to exclude all air.

Finally, the reading can only be made exact by using the mirror formerly described, and estimating the position of the level of the column of mercury in the eudiometer above that in the trough, so that the difference may be brought into the calculation. By reading in this manner the error is avoided, which otherwise would result from heating the gases by the hand

in adjusting the outer and inner levels, and it also enables us to record the results without touching the apparatus, which thus preserves a constant temperature.

It is quite necessary, in estimating the volumes of the gases, to use the substance for absorption in a bulk as small as possible, and in a form which may easily and completely be removed from the tubes, so that the gases may neither be rendered impure by air introduced, nor their reading rendered erroneous by some of the absorbing substance adhering to the sides of the tube. This is best effected by casting the materials into the form of bullets, by means of a common bullet-mould, into which a thin piano wire has been previously introduced. If there are to be two determinations of carbonic acid, the one before the combustion of the gas, the other after, it is necessary to transfer the gas from one eudiometer to another, after the first determination, in order to avoid the chance of error which might result from potash adhering to the side of the tube during the first absorption; and for this purpose it is obviously of little consequence whether the whole or only a part of the volume of the gas be transferred. The adhesion of air to the piano wire is so insignificant, that it might be completely neglected; but to avoid error, it is better to amalgamate the outer surface of the iron wire; this may be done by rubbing it with an amalgam of potassium and mercury, without destroying its tenacity. Rusty iron wire must not on any account be employed, and equal care must be taken to keep its inferior end under the mercury during the absorption; for if it be exposed to the air, an endosmose and exosmose is effected to such an extent, as in certain cases to endanger the value of the analysis.

In order to estimate olefiant gas and the hydrocarbons accompanying it, we have invented a very simple and efficacious method, which may be usefully employed in the analyses of coal gas. A little bullet is prepared out of the same materials as those used for making the negative element of the coal battery. For this purpose a bullet mould, supplied with a platinum wire having a bent end, is filled with a pounded mixture of two parts of coke and one part of coal, and is then heated before the blowpipe flame. The ball made in this way is afterwards dipped into a concentrated solution of sugar, and heated very strongly in the open reducing flame of the blowpipe; it is now ready, and must be preserved for use carefully protected from moisture. This lump of charcoal, about the size of a small pistol bullet, is capable of absorbing into its pores 0·5 gramme of sulphuric acid without appearing wet on the surface, and it can be introduced into and withdrawn from the eudiometer without moistening it to any appreciable extent. For the purpose of experiment it is made to absorb a mixture consisting of one part of anhydrous and two parts of concentrated hydrated sulphuric acid. The proof that the acid contained in the bullet has been sufficient for the absorption of the olefiant gas, is the emission of white fumes in the air after its withdrawal from the mixture of gases, which of course must be quite dry. As the anhydrous sulphuric acid emits vapor possessing considerable tension, and is never obtained free from sulphurous acid, and as the latter gas is also formed by the action of sulphuric acid on the hydrocarbons, an augmentation of the volume of the mixture is thus produced. To remove both these sources of error, after the conclusion of the above experiment, a little dry ball made of gypsum and peroxide of lead is introduced into the eudiometer. This has the

double effect of removing both, for while the peroxide of lead absorbs the sulphurous acid, the anhydrous sulphuric acid robs the gypsum of part of its water, thus becoming hydrated sulphuric acid and losing its tension.

When the oxygen is estimated, not by combustion with hydrogen, but by absorption with phosphorus, the precaution must always be taken to separate the vapors of phosphorous acid by a bullet of caustic potash, before effecting the measurement.

As the tension of the aqueous vapor, and in fact every known precautionary means were adopted in our experiments, we believe it to be unnecessary to enter into further detail. But, at the same time, as it is necessary that we should submit to the Association some proofs of the degree of accuracy which we profess to have attained in this mode of analysis, we do not consider it superfluous to lay before it a series of analyses of common air, made with eudiometers such as have been described, but of various sizes, and with air collected at different times, the analyses being made with the precautions recommended by us. And we are less afraid of being accused of unnecessary detail, because these analyses show most decidedly that the presence of nitrogen during the combustion of hydrogen and oxygen does not cause the formation of ammonia, or of any degree of oxidation of nitrogen. We thought this question, involving as it does the whole value of our labors so important as to be submitted to rigorous experimental research.

The air employed in these experiments was collected in the neighborhood of Marlburg in the open air, and carefully freed from carbonic acid: the measurement of the respective volumes of gases was effected at the maximum of moisture.

I. *Experiments with a eudiometer of small dimensions.*

1st Experiment, June 14, 1844.

	Volume.	Temp. Cent.	Difference of level.	Barometer.
		°	m	m
Volume of air used,	230·1	18·0	0·2075	0·7480
Volume after admission of hydrogen,	307·1	17·8	0·1343	0·7480
Volume after the combustion,	211·8	18·0	0·2250	0·7480
2nd Experiment, June 15.				
Volume of air used,	193·9	18	0·2420	0·7476
Volume after admission of hydrogen,	346·4	18	0·0962	0·7476
Volume after the combustion,	280·2	18	0·1600	0·7476
3d Experiment, June 18, with the same air as the last.				
Volume of air used,	231·4	16.4	0·1963	0·7451
Volume after admission of hydrogen,	322·9	16.2	0·1092	0·7433
Volume after the combustion,	230·8	16.4	0·1969	0·7410
4th Experiment.				
Volume of air used,	214·4	17·3	0·2305	0·7467
Volume after admission of hydrogen,	313·5	17·3	0·1367	0·7478
Volume after the combustion,	234·3	17·1	0·2224	0·7474

II. *Experiments with a eudiometer of larger dimensions such as that used in our experiments.*

5th Experiment, June 30.

	Volume.	Temp. Cent.	Difference of level.	Barometer.
		°	m	m
Volume of hydrogen used,	146·1	17·1	0·2149	0·7460
Volume after admission of air,	313·0	17·1	0·0593	0·7460
Volume after combustion,	216·9	17·1	0·1506	0·7449
6th Experiment, July 1.				
Volume of hydrogen used,	155·6	168·	0·2069	0·7447
Volume after admission of air,	297·1	169·	0·0750	0·7442
Volume after combustion,	214·3	170·	0·1528	0·7444

III. *Experiments with a large, long, and wide eudiometer.*

7th Experiment, July 1.

	Volume.	Temp. Cent.	Difference of level.	Barometer.
		°	m	m
Volume of air used,	663·2	16·0	0·2301	0·7453
Volume after admission of hydrogen,	881·3	16·2	0·0237	0·7453
Volume after combustion,	735·0	16·5	0·1658	0·7448
8th Experiment, July 10.				
Volume of air used,	676·8	16·4	0·2160	0·7444
Volume after admission of hydrogen,	878·7	16·5	0·0225	0·7444
Volume after combustion,	716·6	16·2	0·1667	0·7444
9th Experiment, July 12.				
Volume of air used,	657·2	16·8	0·2408	0·7457
Volume after admission of hydrogen,	890·9	16·8	0·0099	0·7457
Volume after combustion,	752·8	16·8	0·1460	0·7449

From the preceding experiments, the composition of air is as follows:—

Nitrogen.	Oxygen.	
78·92	21·08	Determined by the smallest eudiometer.
78·93	21·07	
78·98	21·02	
78·99	21·01	
79·10	20·90	Determined by a large eudiometer, such as that used in our experiments.
79·09	20·91	
79·14	20·86	
79·10	20·90	Determined by the largest eudiometer.
79·19	20·81	
79·05	20·95	

The great agreement of these experiments with one another, and with the results obtained by the extremely careful experimental determination of the composition of air by Dumas, proves that the eudiometric analyses

of gases admit of a degree of exactness which certainly is not surpassed by the most minute analytical methods; and they further show, that the presence of nitrogen does not exercise any disturbing influence on the estimation of explosive mixtures of gases.

To be Continued.

Extract by the Author, from a Memoir upon the Carbonization of Wood by Surcharged Steam. By M. VIOLETTE.

Translated from the Comptes Rendus de l'Academie des Sciences, for 19th June, 1848, for the Journal of the Franklin Institute.

"Charcoal, as it is prepared and used for the manufacture of gunpowder, and particularly for that for sporting, differs much from pure charcoal, and contains other constituent matters of the wood. The proportion of these matters, which varies with the mode of preparation and the degree at which the charring is stopped, modifies considerably the properties of the powder. For this reason, in practice, the different kinds of charcoal are carefully separated, from the first degree of charring or brown charcoal, *(charbon roux,)* to the black charcoal, which is the most completely carbonized.

"In the first part of my Memoir, after recapitulating the different varieties of charcoal, I give an account of my experiments to determine the successive phenomena of charring in close vessels, and the effects of exposing the wood to different degrees of temperature. I have ascertained that at the temperature of 200° (392° Fah.) wood is not charred; that at 250° (482° Fah.) there is obtained an imperfect charcoal called *brulots;* that at 300° (572° Fah.) the brown charcoal is formed; and that at 350° (662° Fah.) and above, the operation invariably gives the black charcoal. The time necessary for the carbonization varied from half an hour to three hours, and the products passed at will from the brown to the black charcoal. I then examined the yield of charcoal, which is less in proportion as the charring is more advanced.

"In the second part of my Memoir, I give an account of my labors to apply the principles laid down in the first part to the charring by steam. MM. Thomas and Laurent, Civil Engineers, having had the happy thought of applying surcharged steam to the reviving of animal black, I thought that it was possible, by analogy, to extend this process to the carbonization of wood. I found in the first experiments made with a small apparatus, not only a slight gain in the force of the powder, but a much more considerable yield of charcoal. After this first result, the Minister of War advanced me 5000 francs, ($1000,) for the erection of an apparatus on a large scale. In this apparatus the steam is supplied by an ordinary boiler, and passes into a worm wound in a helix. The tube is 0·020 m. (nearly 8 inches) in internal diameter, and 20 metres (22 yards) long; the steam surcharged by the heat of the furnace arrives at a determinate temperature, 300° (572° Fah.) for instance, to obtain brown charcoal. It surrounds and penetrates into a horizontal cylinder containing the wood and chars it; it then leaves the cylinder charged with the products of the distillation.

This apparatus has been in regular operation for nearly a year at the powder mills of Esquerdes, which are under my charge, and supplies exclusively and advantageously the charcoal for the sporting powder. The drawing of it is appended to the present memoir.

"According to the tables which I present, of the results obtained in its current working, I have generally obtained from 33 to 37 of charcoal from 100 of wood; as a mean 35 per cent. of brown charcoal, and 2 per cent. of *brulots*, but no black charcoal. The yield has sometimes been more than 39 per cent. of brown charcoal.

"By the old method, as a mean, 18 per cent. of brown and 14 per cent. of black charcoal were obtained. Thus it is seen that the proportion of the charcoal which it is desirable to produce, is twice as great by the new as by the old process. It is also easy to produce the black charcoal by raising the temperature above 300° (572° Fah.) The preservation of the steam within determinate thermometric limits, (a condition indispensable to the success of the operation,) is easily obtained by the adjustment of the stop-cock which admits the steam;—this is a great advantage essentially belonging to this new method. The examination of the expense of production is also in favor of the new process.

"I then point out the modifications which, according to my observations, might be made in the construction of a new apparatus. That which is now in process of construction upon these data, at the powder mills of Saint-Chamas, will combine the most favorable conditions for this mode of carbonization.

"I then enter into some considerations upon the different proportions of materials to be used in powder, according to the degree of carbonization, and the yield of the wood; the volatile matters which the charcoal still contains, being at some times double the amount which at other times occurs, and forming occasionally two-fifths of the charcoal.

"The quantities of the components of the powder are numerically the same in all the powder mills; but not really so, because the charcoals used, coming from different methods of fabrication, are of variable composition. The exact analysis of different charcoals, which I am about to undertake, will, however, shew the true value of this assertion; and I shall have the honor, hereafter, of presenting this work to the Academy.

"I conclude by pointing out what useful resources the surcharged steam may present to all branches of industry, which employ heat within the thermometric limits of 100° to 500° (212° to 932° Fah.)

"The baking of bread and sea biscuit takes place perfectly in a current of steam heated to 200° (392° Fah.) Successful experiments upon this subject have recently been made at Esquerdes, in presence of an engineer sent by the Minister of the Marine; the continuous baking of bread, so long and vainly sought for, is finally practised by this process. The cooking of meat may also be accomplished by it, and we may be permitted to think that culinary apparatus of this kind, both for large and for private establishments, will replace the old apparatus, the use of which is so dangerous; here there is no peril, for the heated vapor has but a feeble tension (at most half an atmosphere) above the pressure of the air.

"The extraction of wood vinegar, *(pyroligneous acid,)* may also, without doubt, be easily accomplished by this new process; for on the one

hand, the condensed steam carries with it and contains all the products of the distillation without any loss, and on the other hand, the adjustment of the stop-cock for admitting the steam, allows the temperature to be so regulated as to insure the maximum yield of acid. It will also be possible, perhaps, to avoid the formation of that empyreumatic oil which always accompanies pyroligneous acid, and gives it that disagreeable character which does not permit it to be substituted for vinegar.

"The extraction of wood alcohol, *(pyroxylic spirit,)* may also be advantageously accomplished by seeking for the thermometric conditions necessary and sufficient for its maximum formation.

"In fine, the drying of wood may be accomplished by this process with the greatest ease; and the new and strange results which I have obtained, as to the resistance of different kinds of wood, dried at high temperatures between 100° and 250°, (212° and 482° Fah.,) will be the subject of a memoir which I shall soon have the honor of submitting to the Academy."

Description of an Apparatus for Carbonizing Wood by means of Heated Steam. By M. VIOLETTE.

From the London Journal of Arts.

It is well known that the nature of the product of the carbonization of wood, in a close vessel, varies according to the temperature; for instance, a very great heat produces a black charcoal, deprived of the greater part of its volatile hydrogenated parts; whilst a more moderate heat gives a red charcoal, retaining more of the properties of wood, and still charged with volatile principles. It is this latter quality of charcoal which produces the best gunpowder; and it is therefore important to discover the best means of preparing it. With this object in view, M. Violette has, by experiment, determined the limits within which a red charcoal may be obtained: that is to say, a product which is not wood, and yet is not perfect charcoal. To effect this object he employs a bath of metal, fusible at 160°, composed of 1 part bismuth, 4 parts of lead, and 3½ parts of tin. This metal he keeps in fusion in a deep glass vessel, suspended over a Carcel lamp. A thermometer, graduated up to 350° is immersed in this bath to shew the temperature. The pieces of wood to be experimented upon are fastened to the ends of platina wires, and put into glass tubes, closed at one end, and immersed in the metallic bath. By this arrangement the wood is maintained at the temperature indicated by the thermometer, and sufficiently protected from contact with the atmosphere. The wood may be withdrawn for inspection, when required, by means of the platina wires. A suitable and unvaried temperature may be maintained, by raising or lowering the wick of the lamp at the beginning of the operation. The wood exposed in this apparatus during an hour to a temperature of from 200° to 250°, does not become converted into charcoal;—at the end of two hours, at the same temperature, it is converted into red charcoal, its surface being properly carbonized, but its interior being still wood; at the end of three hours it is converted into a hard red charcoal, brittle, and burning with flame, but incapable of extending its combustion; if submitted for an hour to a heat of 300° a very good red charcoal is obtained,

of sufficient hardness, but easily pulverizable; on the prolongation of the experiment to two hours a more perfect charcoal is obtained, which burns with flame; and, lastly, at a temperature of 350°, and at the end of half an hour, a charcoal is obtained which is black, friable, and easily pounded.

The first experiments were made with a small apparatus, capable of containing about 2 lbs. of wood; and, independently of the superior quality of the powder manufactured with the charcoal thus obtained, it was found that the product was augmented to as much as 42 per cent. of the weight of the wood.

The apparatus now employed for this purpose is shewn below; fig. 1 being a longitudinal vertical section, and fig. 2 a tranverse section in the line *a b* of fig. 1. It consists of two hollow concentric iron cylinders, H and K; in the inner one (K) of which the wood to be carbonized is placed.

Fig. 2.

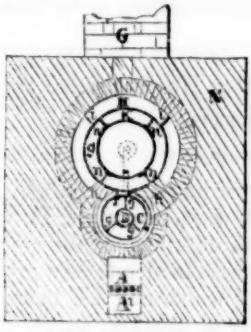
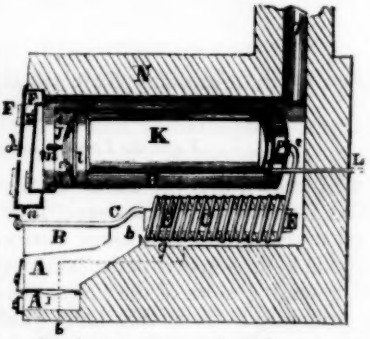


Fig. 1.



C, is a coil of steam pipe, communicating at one end with a steam boiler, and at the other with the outer cylinder, H. A is the fire-place, (which may be fed with wood or coke, or other suitable fuel,) wherein the steam pipe is heated to any required degree of temperature. The cylinder, H, is closed by a wrought iron cover, I; and the apparatus is provided with two outside cast iron doors, F F, by which it is protected from the cooling action of the atmosphere. L is a pipe, for letting off the steam and the products of the distillation of the wood from the cylinder K. G is the flue, for the escape of the smoke from the fire-place A. The whole apparatus is surrounded by brickwork or masonry, N.

The wood to be carbonized is first placed in a cylinder, made either of wirework or perforated metal, which is introduced into the cylinder K; by this arrangement, should the charcoal become ignited on being taken out, the flame will be prevented from spreading. The charge in this apparatus weighs from 30 to 40 lbs.

Mode of Operation.—The first thing to be done is to get up the steam, until the manometer indicates one atmosphere; the fire-place for heating the steam pipe is then to be lighted, and in about a quarter of an hour the doors may be opened, and the perforated cylinder, containing the wood, introduced into the cylinder K, which is then closed by means of the cover I; a luting of clay being made round the edge thereof, and a screw, *m*, applied, to fasten the cover in its place, the outer doors may then be closed. After the lapse of ten minutes, when the luting has become sufficiently

dried, the induction steam cock is opened, and the steam rushes into the steam pipe C, where it becomes heated; from thence it passes into the outer cylinder H, and into the inner cylinder K, at its open end, where it gradually insinuates itself into the pores of the wood, acting, by its great heat, in such a manner as to carbonize it, and finally makes its escape through the pipe L, carrying with it the gases evolved from the wood.—In order to keep the fire at a certain temperature, there is a small glazed opening at *a*, through which the workman can see that the flame acts properly upon the steam pipe. After some time, a thermometer, (specially constructed for the purpose,) on being introduced into the cylinder K, shews that the temperature has reached such a height as to melt tin; and the steam which escapes shews, by its color and odor, that it is mixed with the first products of distillation of the wood, and that the carbonization has commenced. The smoke or vapor thickens, and takes successively various aspects, which are certain signs of the progress of the operation. After about two hours from the time the distillation was first apparent, the smoke shews that the operation is finished. The attendant then proceeds to discharge the charcoal; and for this purpose two other attendants are ready with what is called the *extinguisher*, a large iron cylinder, about three feet in diameter, and about six feet in length, to receive the charcoal. The chief attendant then shuts off the steam, opens the doors F, turns the screw *m*, lays hold, by means of wooden handles, of the respective ends of the cross bar J, which keeps the disk in its place, detaches it, and plunges it into a vessel full of water close by; then, by means of the same wooden handles, he takes hold of the disk, and twisting it round, so as to break the luting, detaches it, and plunges it also into the vessel of water. The attendants holding the extinguisher, put it in a horizontal position in front of the cylinder K, so as to close the orifice.—The chief attendant then pushes a long rod through the pipe L, so as to push the cylinder, containing the charcoal, into the extinguishing cylinder, which is then quickly placed on the ground, and the hydraulic joint, with which it is provided, is filled with water. The operation is then completed.

The inventor has observed that there are no traces of tar in the apparatus, as it is all driven off by the steam. The charcoal obtained is of very fine quality, and varies according to the temperature: that is to say, is *red* or *black*, according to the degree of heat and the length of time during which it has been maintained. The former is suitable for manufacturing the finer sorts of powder for sporting purposes, and the latter, inferior powder, for blasting mines, &c.

The apparatus above described has been in operation more than a year, and has produced 5000 lbs. of superior charcoal, and is now in very good condition.

Various modifications may be made in this apparatus without in any manner altering the main feature of the invention; for instance, the inventor proposes, in some cases, to use an apparatus containing three carbonizing cylinders, one of which shall not be supplied with steam, but merely serve to dry the wood, and prepare it for either of the other cylinders, on either side of the steam pipe; this arrangement has the effect of rendering the operation continuous.—*Bulletin de la Société d'Encouragement.*

Method of Insulating the Metallic Wires intended for Subterranean or Submarine Telegraphic Communications. Extract of a note of M. Dujardin.

"This process consists of two operations. The first is the wrapping of a ribbon of caoutchouc, $\frac{4}{10}$ths of an inch wide and $\frac{5}{100}$ths of an inch thick, around a metallic wire, so that each turn of the wrapping shall cover about one-half of the preceding one. The second consists in wrapping spirally above the caoutchouc, a ribbon of sheet lead, $\frac{16}{100}$ths of an inch broad, and $\frac{4}{100}$ths thick, so that the edge of each turn shall touch the former, but without lapping over it. The leaden envelope serves to protect the caoutchouc from blows."—*(Comptes Rendus de l'Academie des Sciences, for 2d Jan.* 1849.*)*

Explanation of the Diurnal Variations of the Magnetic Needle, and of the Aurora Borealis.

At the session of the Academy of Sciences of Paris, on the 8th of January last, M. Arago communicated a memoir, in which M. Auguste de la Rive explains the diurnal variations of the magnetic needle, and the appearances of the aurora borealis, by the action of magnetic currents which traverse the atmosphere, and have for their physical cause *the inequalities in the temperatures* of the atmospheric column.

FRANKLIN INSTITUTE.

Stated Monthly Meeting.

A stated meeting was held at the Hall, March 15th, 1849.

S. V. Merrick, President, presiding.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations to the Library were received from—The Royal Geographical Society of London; The Royal Astronomical Society, London; Hon J. R. Ingersoll, Hon. A. C. Greene, Hon. J. A. Pearce, Hon. T. O. Edwards, Hon. Charles Brown, and Prof. A. D. Bache, Coast Survey, Washington City; Hon. Zadok Pratt, New York; G. Troost, Esq., Nashville, Tenn.; T. R. Marvin, Boston, Mass.; The American Institute, City of New York; Wm. Minifie, Baltimore, Md.; Prof. R. S. M'Colloh, G. S. Appleton, and Prof. J. F. Frazer, Philadelphia.

Correspondences were read from Prof. Joseph Henry, (referred to the Committee on Meteorology,) Prof. A. D. Bache, and the Royal Institution, London.

The Treasurer reported his monthly statement.

The Board of Managers and the Standing Committees reported their minutes, and also the appointments of their Chairmen, and the time for holding their stated meetings for the ensuing year.

Mr. Geo. W. Smith exhibited and explained an axle for coaches, invented by Chinnock & Co., 42 Cliff street, New York. The wheel is retained on the axle by means of a groove near the outer extremity of the journal, a corresponding groove being also made in the box; a spherical ball of case-hardened steel, about one-fifth of an inch in diameter, rotates in the hollow ring thus formed, and thus confines the box on the axle, dispensing with the use of a linch-pin, &c. The cost, it is said, will not exceed that of the ordinary mail axles.

Mr. Angus Macpherson, of Philadelphia, exhibited a model of an apparatus for inserting screw piles obliquely, without the necessity of resorting to *inclined* platforms, which was explained by Mr. Smith. A ball and socket joint attached to the capstan, enables the workman to walk horizontally with the capstan bars. Pins project from the ball, moving in corresponding slots in the head or socket of the capstan.

A working model of Bain's Writing Telegraph was again presented by request of the meeting, by Mr. James Swaim, the maker of the same, by whom it was put into operation. Mr. Smith explained the nature of the first *Electric* Telegraph, devised by Dr. Franklin in 1752, and a Galvanic Telegraph, publicly exhibited in Philadelphia, in 1809, by Prof. John R. Coxe, in which metallic salts were decomposed on paper moistened therewith—dots, dashes, &c., serving for conventional signs—and alluded to other methods devised by the ingenious Professor, to whom he attributed the earliest experiments demonstrating the practicability of an efficient Chemical Telegraph.

Mr. Wm. Fife exhibited a model and drawings of his apparatus for separating gold dust from the mud, sand, gravel, &c., with which it is found associated. It consists of a vertical tube filled with water; the raw material, sifted into assorted sizes, is successively thrown into the upper part of the tube. The gold, from its greater specific gravity, will more rapidly subside to the bottom, whence it is withdrawn by a movable box or drawer, before the subsidence of the other material.

Mr. I. W. P. Lewis, Civil Engineer, was presented to the meeting by the Chairman of the Committee, Mr. G. W. Smith, and proceeded to explain the subject of "Lighthouse Illumination." The Dioptric Apparatus of the 3d Order large size of Fixed Lights, imported from France by Mr. Lewis, by order of Major Hartman Bache, of the Topographical Engineers, to illuminate the Brandywine Shoal Lighthouse, was exhibited to the meeting in working order.

After a hasty sketch of the ancient methods of illumination, the first steps towards improvement, and the results achieved down to the present time, Mr. Lewis explained, by the aid of diagrams, the optical laws which govern the artist in the construction of reflectors and lenses, by means of which instruments, when illuminated with lamps suited to their respective forms, the effects required by the navigator are obtained.

A comparison was next drawn between the reflector and lens light, as to their relative efficiency and economy. As there is but one lighthouse station in the United States where the lens light has been introduced by

our government, this station was selected as the proper one to illustrate the facts in the case. The double light at Navesink, near Sandy Hook, is the station alluded to, and where there is a fixed and revolving light exhibited from two towers distant from each other 100 yards.

Prior to the introduction of the lens light, the fixed light was produced by 17 Argand lamps, set in paraboloidal reflectors of 14 inches diameter, and the revolving light by 14 lamps, arranged in two groups of 7 lamps each, occupying the opposite faces of the rotating frame,—the reflectors being 14 inches diameter. The first was superseded by a dioptric fixed light of the 2d order of Fresnel, and the second by a dioptric revolving light of the 1st order of Fresnel. The 17 lamps and reflectors of the fixed light illuminated 255° of the horizon, by the consumption of 765 gallons of oil in one year, and with a mean brilliancy of 55 burners of Carcel; while the dioptric light of the 2d order illuminates 300° of the horizon, by the consumption of 517 gallons of oil in one year, (1841,) and with a mean brilliancy, uniformly spread over the horizon, of 350 burners.

With these data, the comparative value of the two modes of lighting is ascertained by the same method adopted by Alan Stevenson, Esq., Engineer to the Commissioners of Northern Lighthouses, viz., 55 burners × 255° of horizon = 14025, and this product divided by 765, the number of gallons of oil consumed in one year, (1840,) gives 18⅓ burners for the useful effect of the reflecting light, maintained throughout the year, by the combustion of a gallon of oil. The dioptric light, on the other hand, has a mean effect of 350 burners, spread over an arc of 300°, which numbers, multiplied together, produce 105,000, and this product, divided by 517, the number of gallons of oil consumed in the year 1841, give 203 burners as the useful effect of the lens light, maintained throughout the year, by the combustion of one gallon of oil; or in other words, the lens produced in this case *eleven times* more effect than the reflector, by the combustion of the same quantity of oil.

In the case of the revolving light the difference is still more remarkable. The greatest power of a 14-inch reflector of 3 inches focal axis, illuminated by a ¾-inch Argand burner, would be 103 burners of Carcel, and its mean effect over a sector of 15° would be 55 burners. Giving the reflector the benefit of the higher value, the effect of the group of seven lamps on one side of the rotating frame would be 721 burners, or 1442 burners, the entire effect of the revolving light. The revolving lens light has 8 faces, and the value of the luminous beam from each face is 4000 burners of Carcel, and the aggregate value of the system of 8 lenses is, therefore, 32,000 burners. The quantity of oil consumed in the year 1840 by the 14 lamps, appears to have been 630 gallons, and the consumption by the dioptric light, 701 gallons.

Now, according to the formula of Mr. Stevenson, as above, the results of comparison will be thus:

Reflectors, $1442 \times 360° = 519120 \div 630 = 824$
Lenses, $32000 \times 360° = 11520000 \div 701 = 16433$
} Diff. 15609.

Which is equivalent to saying, that, by the combustion of *like quantities of oil*, the useful effect of the flash from the 7 reflectors was 412 burners, and the useful effect of one lens 2054 burners, or about five times more light obtained by the combustion of one gallon of oil. The practical value

of the two lights, leaving out the question of "consumption of oil," is this: The reflecting light illuminates 2 sectors of the sea horizon, with a brilliancy equal to 721 burners over each sector; while the lens light illuminates 8 sectors of the horizon, with a brilliancy of 4000 burners over each sector.

The lateness of the hour prevented Mr. Lewis from extending his remarks over other points of the subject possessing the highest interest.

BIBLIOGRAPHICAL NOTICES.

School Architecture, or Contributions to the Improvement of School Houses in the United States. By HENRY BARNARD, *Commissioner of Public Schools in Rhode Island. New York: A. S. Barnes & Co. Cincinnati: H. W. Derby & Co.* 1849.

This volume contains a great deal of very useful information for those who have charge of the construction and arrangements of our public schools. The public attention ought, by this time, to have been fully awakened to the injury that is done to the young scholar, by confining him within too narrow a space, or restricting him to an unnatural position of the body; and above all, by denying to him a full supply of fresh air for his lungs. It is true, and it is as strange as true, that so little practical use has been made of a principle which every one is willing to admit as correct and important. Of the public buildings in our city, scarcely one has any provision whatever for ventilation; and in one of them, the ventilating passages left by the architect, have actually been blocked up by the building committee, probably for fear their company will stay too long within their halls. But this has not been the case in the public schools which have recently been constructed. In them proper means have been adopted, and we believe with satisfactory results, for the supply of that great necessary for health—fresh air.

The volume of Mr. Barnard contains a great many useful suggestions, as to the various arrangements for promoting the physical comfort of the scholars, and is fully and very lucidly illustrated by drawings and plans, in which the plans proposed are so fully represented as to make the work a very valuable one. F.

Theory and Practice of Teaching; or the Motives and Methods of Good School Keeping. By DAVID D. PAGE, A. M., *Principal of the State Normal School, Albany. Tenth Edition. New York: A. S. Barnes & Co. Cincinnati: H. W. Derby & Co.* 1849.

We hail this very pleasant book as an evidence that there are some left still, who regard teaching as a profession and not as a mere trade,—as a work in which a man of intelligence may engage lovingly, and not as a mere drudgery by which he is to earn his daily bread, while his mind is engaged on other pursuits. To any one who has occasion to engage in